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AMERICAN POTASH INSTITUTE, INC.

INVESTMENT BUILDING **WASHINGTON, D. C.**

Better Crops with PLANT FOOD

The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

Editorial Office: Investment Bldg., Washington, D. C.

VOLUME XXIII NUMBER FOUR

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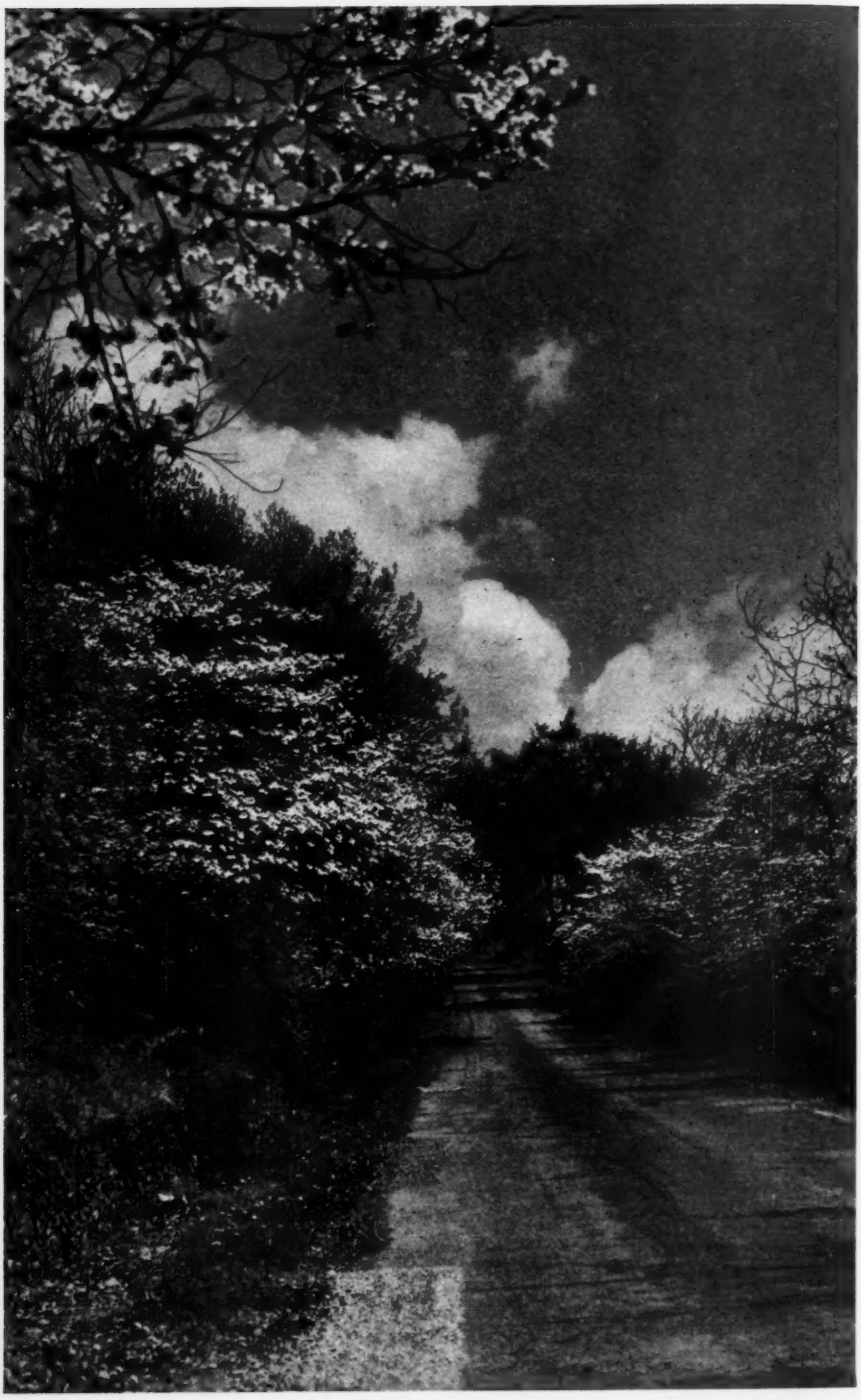

WITH ENTICING COLOR AND FRAGRANCE, BYWAYS INVITE THE WINTER-WEARY INTO THE OUT-OF-DOORS.

Better Crops with PLANT FOOD

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VOL. XXIII WASHINGTON, D. C., APRIL 1939 No. 4

Our wild friends welcome a little —

Neighboring With Nature

Jeff McDermid

YON FARMER breaking the April clods is a neighbor of nature, animate and inanimate. You might say he leads a "wild life" and must needs be conversant with nature's ways to make a success of his risky occupation. In the last analysis the farmer is the custodian of the entire range of natural history outside of government parks, but this phase of his conservation stewardship is not mentioned as frequently as his production partnership with soil and sunshine.

At this time of the year we advise with him about dosing curculio, basting potato bugs, asphyxiating aphids, and demolishing rats. We think of the farmer merely as a pawn in the gambling game of wild life versus civilization and orderly crop production. Any "wild life" he meets at roadside taverns and grog shops comes as an incidental relaxation to the pursuit of noxious vermin and plant pests galore. Maybe our extension efforts are not as acutely tuned to the community aspects of Mr. Farmer as a game preserver and a fish conservationist as our aids to him in the extermination of slugs and cutworms.

And it's not all a matter of guns and tackle either. If it were, we might be safer. For in a recent survey of my own among about two hundred farm lads, I find that seventy per cent of them

own plenty of rifles and other shooting gear, while sixty-five per cent take time off to wade out where the trout are leaping near the falls. Many a farm boy who is an expert with rod and reel or busy with a blunderbuss is not an adept at the real job of conserving our natural resources. To do that well it takes a heap of patience, a flair for research, and a set of positive native convictions which our commercialized agriculture does not often foster. I think it can be best expressed in a quotation from a friend of mine who is nationally known for wood lore and friendship for our native landscape. He says:

"THUS far we Americans have escaped regimentation by our own rulers, but have we escaped regimentation by our own ideas? I doubt if there exists today a more complete regimentation of the human mind than that accomplished by our doctrine of ruthless utilitarianism. Can a man afford to devote land to woods, marsh, pond, and windbreaks, which often yield non-economic benefits? Can a man afford to devote fence rows to the birds, and leave hollow trees for the coons and flying squirrels? Here utility shrinks to what the chemist calls a trace. Can a man afford to devote land to historic oak, a patch of ladyslippers, or a remnant of the old prairie, or just maintain it as scenery? Here utility shrinks to zero. Yet conservation is any or all of these things. To entirely remove any natural feature from the rural landscape is a defacement which the calm verdict of history will not approve, either as good conservation, good taste, or good economics."

This man just quoted has certain farmer friends, sadly in the minority of course, who see things as he does. One group of these queer fellows, right in the midst of a lean price year, devoted some arduous hours to planting tamarack seedlings, and strange enough, not for the wood therefrom in years to come, but simply because pink ladyslippers and other summer flowers are known to grow in profusion beneath tamarack boughs. Sometimes such efforts fail, and nature rebels at the flirtation. Yet when the experiments are repeated and finally succeed, there comes as much genuine satisfaction as running a binder through a field of bumper barley.

There is another branch of outdoor enthusiasts who favor State and national recreation projects wholly or largely for the sake of the fish and game they hope to bag. Here the same old American trait of utilitarianism arrives to plague us once more. They point out quite soundly that my home State once abounded with all manner of wild species, at home in woods and waters, but that the Indian population subsisting upon the fruits of the chase was a meager one. They declare that the original inhabitants of my State numbered less than ten thousand, whereas today the conservation wardens issue hunting permits to two hundred thousand annual wanderers of the wild.

Then they claim that the farmers selfishly intrude their petty private rights by erecting barriers and warning signs, regardless of the census taken of the deer and the pheasants. The Indian hunter crept along on hands and knees with bow and arrow, while the modern slayers motor afield in shoals and volley with high-power weapons. Taken on all sides of the argument it makes a pretty debate for the ever-practical but non-poetical conservationists.

AS a rule the farmer erects these warning signs to protect his fields from excessive tramping and his crops from abuse. In only a few instances does the farmer possess the kind of poetical attitude toward the scenery as that which my friend upholds. Or he may want to save the game for his own rifle, caring little or nothing for the community side of the question.

It's a question of natural resources which makes wild life abundant. The resources must be kept in working order, my expert friend advises. Re-

sources, or subsistence, for the wild bird or roaming animal, depend on many intricate relationships. If any of these relationships get out of order or depleted, then we face possible extermination of the species in that locality. He reminds us in mighty true language that such resources are something to be studied and observed continually in the management of any piece of land. To exert caution and abstain from shooting or fishing or trapping is not the only answer here. Erosion and pollution of our waterways have caused the value of many streams to recede as haunts of game fish. To quit fishing them is surely not enough. The sickening of resources and the neglect of nature's balances are at the root of half our wild-life conservation problems.

TO this end, therefore, it is wisely argued that the farmer as the landowner and the next-door neighbor to the denizens of woods and waters is the key to the future conservation of our fauna and flora.

We have him hog-tied to the theory of soil conservation. Nine out of ten farmers embrace such doctrine with fervor and profit by it. The few who don't ought to know best how soon the mortgage will be foreclosed, if shiftless land neglect is persisted in. But the other kind of conservation, the kind we dwell upon here for awhile, cannot be measured directly in terms of yields, interest rates, or mortgage moratoriums. This is because it deals with intangibles. Like a pretty sunset, or a fawn pausing to drink at the edge of a rivulet, or a dogwood blooming amid some ferns, or a vista down a dreamy valley. The most practical brand of conservation speaks to us clearly and vigorously in terms that mean something at the bank window. We must use it to the utmost, but does its wider use mean that the other kind of conservation needs be overlooked or branded as spinsterly sentimentality?

Even in urging wiser land use for wild life refuges one can bait the idea with the red meat of monetary returns. That is, we can instill a certain ardor for this task in the minds of utilitarian folks by showing how one might propagate game under State license and farm out the shooting rights. It is done to a turn in many areas of the country, and seems to afford no end of joy to the hungry hunters from afar. If, in order to convert more folks to studious conservation practices, this farming-for-killing plan is necessary, it has no serious objections if properly safeguarded. There are one or two men in my State who have made a wonderful record at this business, at least one of them going into it after a few years as a conservation warden of wide reputation. On larger than average tracts where land values are not very high for farming, we see possibilities in such nature museums.

But just because this works out fairly well on big places, it doesn't answer the problem for the wild life refuge and nature laboratory to be maintained on the old home farm of small acreage. Yet times have altered the situation thereabouts and perplexed the operator beyond endurance sometimes, compared with circumstances surrounding the nature study of our boyhood days.

He has been obliged to "mop up" everything slick and clean. Drainage and tile have come into the picture. Concrete dams and cement causeways,

(*Turn to page* 46)

Fertilizing Potatoes in New England

By Ford S. Prince

New Hampshire Agricultural Experiment Station, Durham, New Hampshire

IT IS impossible to tell exactly what proportion of the fertilizer sold in New England is used on the potato crop. But a glance at the dusty statistics reveals the fact that in the year 1936 New England produced 229,000 acres of potatoes and New England farmers purchased 289,000 tons of fertilizer.

Now we know that in Aroostook County, Maine, which produced 70 per cent of the entire New England potato acreage during that year, growers apply a ton or more of fertilizer per acre. At least they use the equivalent of a ton or more of 20-unit fertilizer. This same fact applies to the commercial potato growers in the other States. So if we juggle these figures around and adjust them for possible high analysis tonnage, we eventually are forced to the conclusion that potatoes take a huge slice, say at least 60 per cent, of all the fertilizer sold in the New England States.

Cheaper fertilizers during the past decade have brought about the use of more plant food on the potato crop. Not many years ago we were startled with the news that "Maine growers are now using a ton of fertilizer per acre." During the past year or two, we are told, this amount has increased to 2,400 pounds of a 5-8-7 or 4-8-10 or their equivalents. The same story is true in New Hampshire, as according to our 300-Bushel Club records, fertilizer applications have increased from an average of 1,900 pounds in the early years to around 2,300 pounds at the present time, although the figures vary a little from year to year, depending more upon what growers received for their old crop rather than with what they hope to get for the one on which the fertilizer is used.

The question naturally arises as to whether all this plant food is justified and whether it is being used with economy. There seem to be two points of view among farmers in regard to the amount of plant food to apply. One of these recognizes the potato as a weak feeder, and growers who look at it from this angle apply fertilizers in such amounts that their crops will never want for plant food at any time during the growing season. The other group takes into account plant food that may be made available in the soil itself through the decay of organic residues and other natural processes and use minimum rather than maximum amounts of fertilizer material.

How Much Can Be Used?

Neither group of growers neglects the economy angle, for in the former will fall certified seed producers, farmers with preferred markets near cities and the like, while in the other class may be found the men who are at some distance from the market or those who use a short rotation in which clover sods or green manure crops are utilized as a means of bolstering up the fertility of their soils.

If we look at the matter from a sensible viewpoint, we will certainly conclude that the nearer we approach the ideal in climate for potatoes, the more fertilizer can be used profitably. If we assume that the average grower can pro-

duce potatoes at a profit one year with another, the farmers of northern New England can apply more plant food with economy than those of southern New England. This is true because the weather is more often a limiting factor in southern New England, since extreme heat often reduces yields there and rainfall appears to be more variable, extremes in both directions often playing havoc with potato yields and rendering fertilizers ineffective.

The unfortunate part of taking the weather into account is our inability to forecast it. If a farmer knew it was going to be particularly hot or very dry, or even very wet, he might adjust his fertilizer application to meet the situation. However, no one yet has succeeded in predicting climatic conditions so far in advance, and this is probably why most growers plant their potatoes with ample plant food, doing their part in the beginning whether the weather man comes through or not.

What are the arguments for heavy fertilization of potatoes? First and foremost the feeding habits of the plant itself demand it. The fact that the potato is a weak feeder is recognized all over the world and in all the principal potato-growing countries large amounts of fertilizer are applied for the crop. Then, too, when both tops and tubers are taken into account the crop uses a great deal of plant food, as much as 135 pounds of nitrogen, 45 pounds of phosphoric acid, and 144 pounds of potash in a 300-bushel crop, leaves and tops, not counting the plant food that is left behind in the soil in the roots.

Consider Crop Requirements

If we consider the crop as a weak feeder, and wish to have no limiting plant-food factor in the soil during the growing period, then it is easy to harmonize our ideas of a ton or more of 20-unit fertilizer per acre with the needs of the growing plants. One ton of 5-8-7 fertilizer will supply 100 pounds of nitrogen, 160 pounds of phosphoric acid, and 140 pounds of potash. True, this is somewhat less nitrogen than a good crop of potatoes will utilize. The potash applied just about balances with the needs of the crop, while the phosphoric acid is in excess of requirements. However, even with the most careful placement of the fertilizer, a good deal of the phosphoric acid will be fixed before the plants have a chance at it, so

A yield of 556 bushels of potatoes per acre resulted from the use of one ton of 4-16-14 fertilizer. This is the highest yield ever obtained on any plot at Jackson Farm, Colebrook, New Hampshire.

that an excess of this element is always required.

We are inclined to believe, after a dozen or more years of experimental work in fertilizing potatoes with varying amounts of these three elements, that soils vary considerably in their requirements for excess elements over those actually needed by the crop. This is especially true of phosphoric acid and potash. We must consider, for these two elements at least, that the soil itself has a certain hunger or affinity for the applied nutrients. The extent of this hunger depends upon a good many factors; for phosphorus, upon the acidity of the soil and the amounts of soluble iron and aluminum present, and for potash upon the degree to which the element potassium will enter into the base exchange complex, or the extent that it will become rather firmly fixed in the mineral complex of the soil. These factors are governed in large measure by the past history of the soil in question and especially by the degree in which the appetite of the soil has been satisfied by previous applications of these plant foods or of other substances that will accomplish the same result. The length of the rotation for potatoes and the amount of time that elapses between plant-food applications are undoubtedly determining factors in the needs of the crop and in the excesses of these elements that should be applied.

Less Response to Nitrogen

With nitrogen the story is a little different. Practically all of the nitrogen in fertilizers is available during the growing season, and in most rotations some crop residues are plowed down which will yield up nitrogen for the crop during its period of growth. Furthermore, manure is often used for potatoes, thereby reducing the need for fertilizer nitrogen. Another factor to take into account, too, is that potatoes are less responsive to increments of nitrogen than they are to the other two elements in tuber production, although top growth is unduly promoted by excessive application of nitrogen, often to the disadvantage of the crop in seasons where blight is a menace.

I realize that I have made some statements that may require statistics for proof and these I will now proceed to set forth.

Results of Experiments

Since 1928 we have conducted a fertilizer experiment with potatoes on the Jackson farm, near Colebrook, in northern New Hampshire. During the first two courses of the rotation the amounts of fertilizer as well as the amounts of the individual elements were varied. The results of the first years of this test have been reported in BETTER CROPS, but as they are apropos to this article the gist of our findings are here restated.

The use of a ton of 4-8-7 fertilizer resulted in an increase of 75 bushels of potatoes when compared with a half-ton application. Another 1,000 pounds of fertilizer over the ton application brought in but 38 bushels of potatoes. This would indicate that in amounts up to one ton the fertilizer was applied with a handsome profit, but that the economic limit lay somewhere between 2,000 and 3,000 pounds, probably nearer the ton than the ton and a half application.

Omitting all the potash from the fertilizer in a 4-8-0 caused a decline in yield of 162 bushels per acre when compared with a 4-8-7, one ton in each case. Omitting the phosphorus in a 4-0-7 resulted in a decrease of 108 bushels, while leaving out the nitrogen in an 0-8-7 resulted in a yield decline of only 33 bushels per acre. The Green Mountain variety of potatoes was used in the years reported. It is interesting to note that the White Triumph, an early potato, was grown one year and this variety gave a larger decline for phosphorus omission than for potash, suggesting varietal differences in fertilizer response. The principal point to note here, however, is that the potato crop is very sensitive to a lack of potash and

phosphorus, much more so than for nitrogen, and a deficiency of either one may play havoc with yields.

In this test the elements were increased individually over the 4-8-7 standard. The 4-16-7 plots gave an average increase of 39 bushels per acre, the 4-8-10 plots 25 bushels, while the 8-8-7 series came through with but a 7-bushel increase.

It was unfortunate that the potash in this test wasn't increased to a 4-8-14. If it had been, doubling the potash would probably have given an equivalent increase to the doubled phosphoric acid plots. The interesting point, however, is that in both cases the increase in potatoes paid a handsome profit, those being grown with extra phosphoric acid costing, for fertilizer, about 20¢ per bushel, and for potash about 10¢ per bushel!

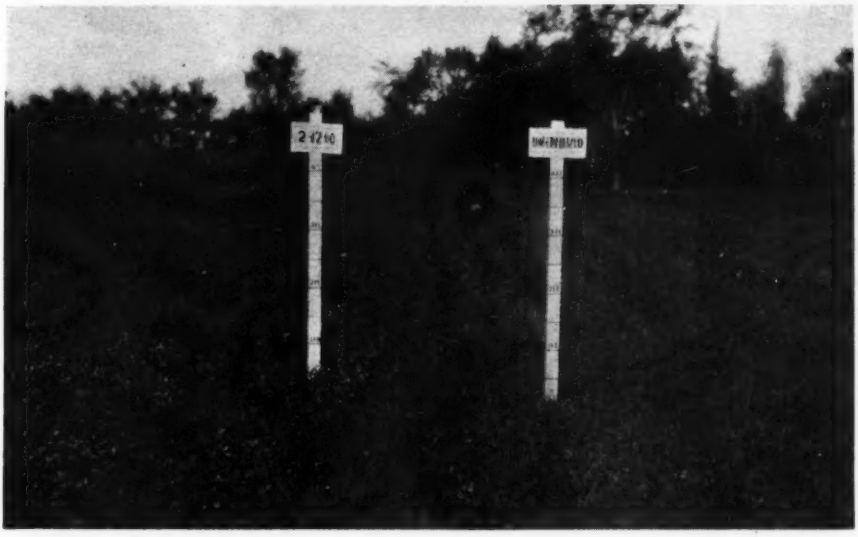
After the first two courses of the rotation on this field, the experiment was revamped, again in a 3-year rotation of potatoes, oats, and mixed hay. The 4-8-7, one ton per acre application, was continued as a standard treatment, but other treatments differed in the main from those in the original plan.

One of the 4-8-0 series was continued and these plots have shown an average annual yield decrease of 153 bushels per acre during the past 5 years. These plots were limed, however, and the clover in the hay crop grows much stronger here than on unlimed portions of the field, a factor which may be boosting yields to some extent over what they might show otherwise.

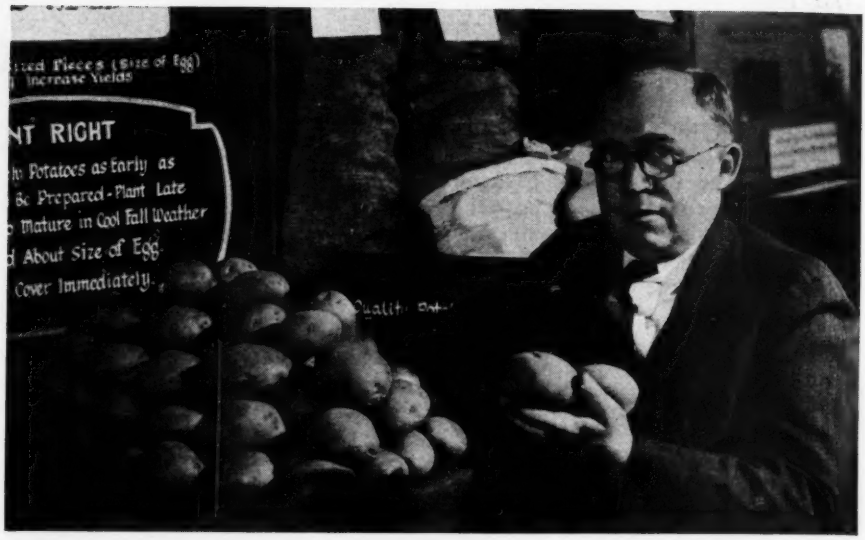
A new series introduced into this test at the time of change was one receiving a ton of 4-16-14 fertilizer. In this one the phosphoric acid and potash have both been doubled over the standard 4-8-7 and the 5-year average increase for this series is in the neighborhood of 40 bushels per acre. At current costs of materials these potatoes have been produced at a cost of not much more than 30¢ a bushel.

It is true that the yield variations on this field during the second period have

(*Turn to page* 45)



Fertilizer made the difference in this clover. 500 pounds of a 2-12-10 fertilizer were applied broadcast at the time of seeding down with oats and clover in 1928. The land had previously grown two crops of potatoes and had over a ton of 5-8-7 applied per acre each year (pH of 5.6). The picture shows rowen, the second crop. The plot on the right had no fertilizer at the time of seeding down, only residual fertilizer left from potatoes. The plot where clover was plowed under (left) produced 11.2 barrels more potatoes per acre than timothy sod.



Whitney K. Gast of Fulton County was named "Indiana's Champion Muck Crops Farmer" for 1938.

A Champion Farmer Knows His Soil

By Roscoe Fraser

Muck Crop Specialist, Agricultural Extension Service, Lafayette, Indiana

WHITNEY K. GAST, Fulton County muck crops grower, was named "Indiana's Champion Muck Crops Farmer" for 1938. This honor was bestowed upon him after a special committee had reviewed and analyzed the records of scores of progressive muck crops farmers scattered throughout the muck area.

"Whit," as he is known to his hundreds of friends, was selected for the honor not for the points he may have made from the "free throw line," but for the winning score he was able to pile up from the "field" through the use of good farm practices, including the proper analysis of fertilizer for each type of soil and crop.

To learn something of Whit's performance last summer, we now turn to the records on file at the Purdue University Horticultural Department.

The "Distinguished Muck Farmer" grew 44 acres of hybrid corn that yielded slightly more than 104 bushels per acre on the best 5-acre plot, 10 acres of onions that yielded 900.59 bushels on the best acre to win for him the State Onion Championship, and 52 acres of potatoes that yielded 412.01 bushels on the best acre. Is it any wonder Whit was selected for that "master of muck" honor?

Naturally the question arises of how he managed his muck and the crops he grew on it. And, therein we find sound, practical, logical information as abundant as the crops he grew.

First of all, Whit, a Purdue School

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Cotton Fertilizer Tests on Two Valley Soils

By I. E. Miles & Russell Coleman

Mississippi Agricultural Experiment Station, State College, Mississippi

IT HAS truthfully been said that the Southeastern States have the poorest soils from the standpoint of plant-food nutrients of any important agricultural area in the United States. It can and should be added that it is probably the most adaptable area in the United States. By the proper use of lime, leguminous green-manure crops, commercial fertilizers, and proper managerial practices, most of the important staple crops can be grown in this area. Such cannot be said of most of the other agricultural areas. It is of importance to note that most of the factors necessary to adapt these soils to the production of crops originate within the same area. This is particularly true of phosphorus and lime. Enormous quantities of free nitrogen may be brought into play by the proper use of leguminous green-manure crops.

On the basis of the foregoing reasoning, it is obvious that commercial fertilizers play an important role in crop production, and enormous quantities are used. Until recently the vast majority of fertilizers used in the United States was used in the 11 Southeastern States. One agricultural leader from a high-producing vegetable area very aptly expressed the situation when he said, "We lose more fertilizer on the way to the field than most folks use."

Applying large amounts of fertilizers is expensive, and must be based upon a knowledge of the needs of the crop and the soil concerned. Otherwise the practice that should be the saving grace of the situation may actually be the

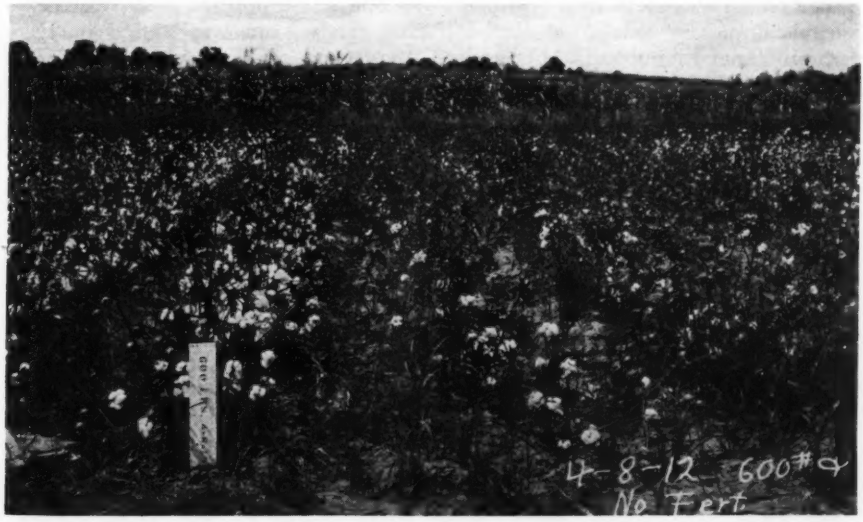

Fig. 1—Cotton yields as affected by 600 pounds of a 4-8-12 fertilizer mixture (left) as compared to no fertilizer treatment (right).

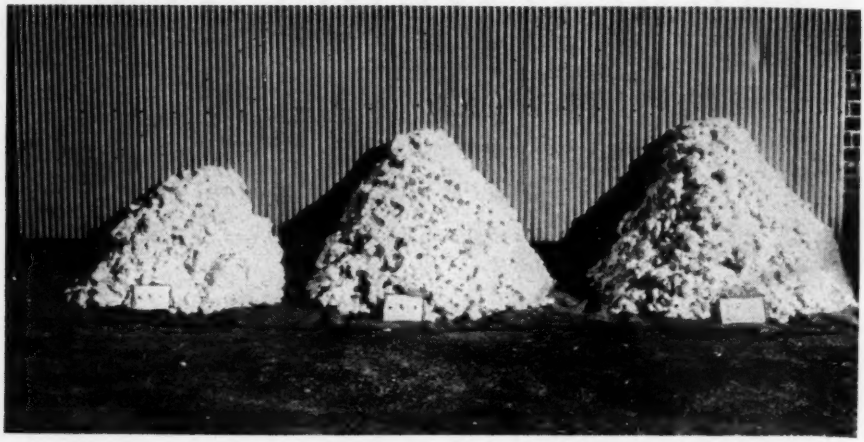

Fig. 2—Cotton yields as affected by increasing potassium from 24 to 36 to 48 pounds of potash per acre, reading from left to right.

thief in the night. Vast amounts of work are done by the experiment stations in an attempt to secure this knowledge. The soils are many and varied, and consequently the fertilizers which are best for a given crop on one soil may not be best for the same crop upon another soil. Since there are hundreds of soils within the boundaries of our own State of Mississippi, it is practically impossible to determine the proper fertilizer for every soil in the State. This paper will discuss fertilizer treatments on two important soils.

Fertilizer rates and ratio tests under cotton have been conducted upon Lintonia silt loam and Ocklockonee fine sandy loam for the past 13 years. Lintonia is a second bottom soil of loessal origin and is well above the average in productivity. Ocklockonee is also a valley soil, but is in general of coastal plain origin, and is about average in productivity. This particular Ocklockonee soil, however, is a productive soil as shown in Table 1 on the unfertilized plot. The reason for its being more productive than the average Ocklockonee soil is due to its being surrounded by limestone hills, which no doubt have contributed very liberally to the fertility of the valley soil.

The test conducted upon Ocklockonee sandy loam was started in 1925. Very good response was secured from potassium treatments. Due to the good response, and in view of the fact that potassium treatments did not exceed 48 pounds of K_2O, the question was raised as to whether maximum response to

TABLE 1—YIELD OF COTTON TEST CONDUCTED ON OCKLOCKONEE SANDY LOAM—1925–1930

Fertilizer Treatment	Yield in pounds of seed cotton per acre						
	1925	1926	1927	1928	1929	1930	6-Year Average
600# 4-8-8	846	658	1,569	1,211	977	1,191	1,075
600# 4-8-6	879	578	1,517	1,128	949	1,176	1,038
600# 4-8-4	814	604	1,455	1,207	916	1,119	1,019
600# 4-8-2	749	541	1,288	963	720	859	853
600# 4-8-0	548	382	931	675	399	682	603
600# 4-8-4	786	474	1,346	997	730	1,103	906
600# 6-8-4	832	538	1,381	1,114	800	1,159	971
600# 4-6-4	783	508	1,405	1,067	771	1,105	940
600# 4-4-4	725	100	1,387	1,078	690	1,073	909
1200# 4-8-4	1,193	642	1,718	1,364	867	1,263	1,175
1800# 4-8-4	1,209	593	1,687	1,258	909	1,370	1,171
2400# 4-8-4	1,109	598	1,757	1,216	777	1,489	1,158
No fertilizer	560	370	877	602	395	590	566

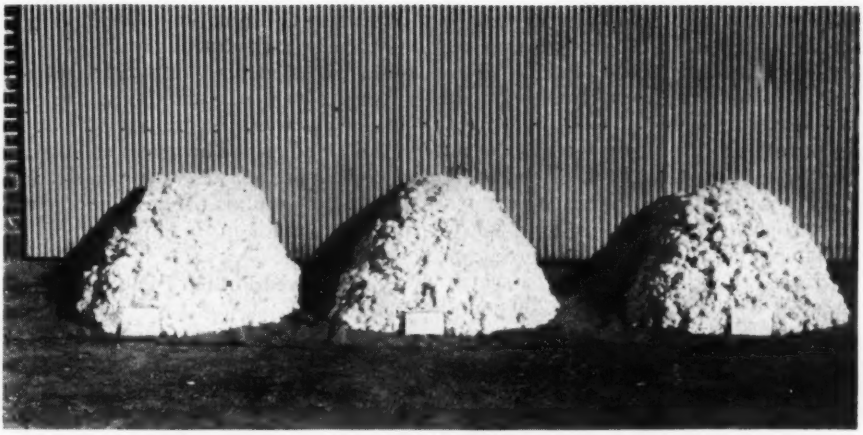

Fig. 3—Cotton yields as affected by increasing nitrogen treatments from 24 to 36 to 48 pounds of nitrogen per acre, reading from left to right.

potassium had been reached in the test. In order to ascertain this point, the potassium was increased after the first 6 years. The treatments, as well as the fields for the first 6 years, are shown in Table 1. The treatments and yields from 1931 to 1938, inclusive, are shown in Table 2.

The data were analyzed statistically according to the method of Love. Analysis of Table 1 revealed that a difference in yield of 108 pounds was required to show significance. The unfertilized plot had an average yield of 566 pounds of seed cotton, which was about the same as the average for the State during the same period. All fertilizer treatments showed significant increases in yields over the unfertilized plot, except the 4-8-0 treatment, which gave an increase of only 37 pounds over the unfertilized plot. When 2 per cent potassium (12 pounds of K_2O) was added, making a 4-8-2 treatment, an average increase of 251 pounds of seed cotton per acre was obtained. When 4 per cent potassium (24 pounds of K_2O) was added, a much greater yield was secured, the 4-8-4 treatment yielding 416 pounds more than the 4-8-0 treatment. Further increases in potassium treatment failed to give significant increases over 4 per cent.

Phosphorus and nitrogen, being almost universally used under cotton, were not entirely excluded from any fertilized plot, the minimum being 4 per cent in both cases. The 4-6-4 treatment increased the yield only 31 pounds over the 4-4-4 treatment. When the

TABLE 2—YIELD OF COTTON TEST CONDUCTED ON OCHLOCKONEE SANDY LOAM—1931–1938

Fertilizer Treatment	Yield in pounds of seed cotton per acre								8-Year Average
	1931	1932	1933	1934	1935	1936	1937	1938	
600# 4–8–12	710	1,233	905	1,112	967	1,954	1,831	1,417	1,266
600# 4–8–8	621	1,214	913	1,086	990	2,066	1,671	1,358	1,240
600# 4–8–6	647	1,169	861	1,039	950	2,102	1,608	1,435	1,233
600# 4–8–4	678	1,064	827	1,023	914	1,865	1,394	1,404	1,146
600# 4–8–0	530	677	550	838	723	1,373	564	1,024	785
600# 8–8–4	585	1,131	933	1,162	1,023	2,023	1,785	1,448	1,261
600# 6–8–4	612	1,314	884	1,125	990	1,878	1,801	1,454	1,257
600# 4–6–4	645	1,356	857	1,185	960	1,867	1,867	1,375	1,264
600# 4–4–8	629	1,342	877	1,178	944	1,874	1,895	1,420	1,270
1200# 4–8–8	630	1,347	987	1,184	1,132	1,610	2,005	1,371	1,283
1800# 4–8–8	432	1,281	982	1,037	1,155	1,647	2,091	1,171	1,225
2400# 4–8–8	464	1,213	813	1,100	1,115	1,370	1,768	979	1,103
No fertilizer	444	704	320	735	604	1,198	472	753	654

phosphorus was increased to 4-8-4, however, an increase of 110 pounds over the 4-4-4 treatment was secured. This barely comes within the limit required for significance.

Increasing the nitrogen above 4 per cent failed to give any increase at all.

Increasing the application of fertilizer above 600 pounds of 4-8-4 to 1,200 pounds resulted in a significant increase, but even the value of the increased cotton from the 1,200-pound application is not great enough to pay for the cost of additional fertilizer. Further increases were of no value.

In 1931 the potassium treatments were increased. The results secured are reported in Table 2. When the data were analyzed, they were found to be very similar to those in Table 1. In this case, however, an average difference in yield of 171 pounds was required to show significance. The unfertilized plot had an average yield of 654 pounds, and the 4-8-0 plot yielded 131 pounds more, which is not sufficient to show any significance statistically. When 4 per cent potassium was added, giving a 4-8-4 treatment, an increase of 361 pounds was secured over the 4-8-0 treatment. Further increases in potassium treatments failed to give significant increases over the 4-8-4.

Increasing the phosphorus above 4 per cent failed to give any increases. Increasing the nitrogen above 4 per cent in the 4-8-8 treatment to an 8-8-8 resulted in an increase of only 21 pounds of seed cotton per acre. The same relation was found in the rates of application studies. The greatest increase over 600 pounds of 4-8-8 was secured with 1,200 pounds of 4-8-8, and it was only 43 pounds in this instance.

Showed Potash Deficiency

Fertilizer studies conducted upon this field over a period of 14 years show it to be very deficient in potassium for the particular crop concerned. The nitrogen, phosphorus, and potassium studies are not absolutely comparable in that neither phosphorus nor nitrogen was entirely excluded from any treatment. As a matter of fact, increases in yields of seed cotton due to potassium treatments when 24 pounds of K_2O were exceeded, were very small; just as was true of nitrogen and phosphorus. However, when the 4-8-0 treatment is compared to the unfertilized plot and the 4-8-4 plot, it is conclusively shown that potassium was the limiting factor. Figures 2, 3, and 4 show the yields of seed cotton as affected by increasing potassium, nitrogen, and phosphorus treatments. Figure 1 shows the difference in yields on an unfertilized plot com-

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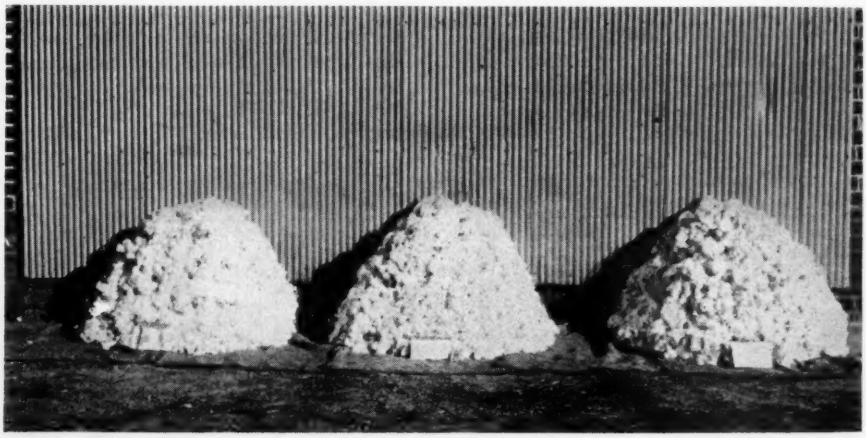


Fig. 4—Cotton yields as affected by increasing phosphorus treatments from 24 to 36 to 48 pounds of phosphorus per acre, reading from left to right.

Why Southern Illinois Needs More Potash

By H. L. Garrard

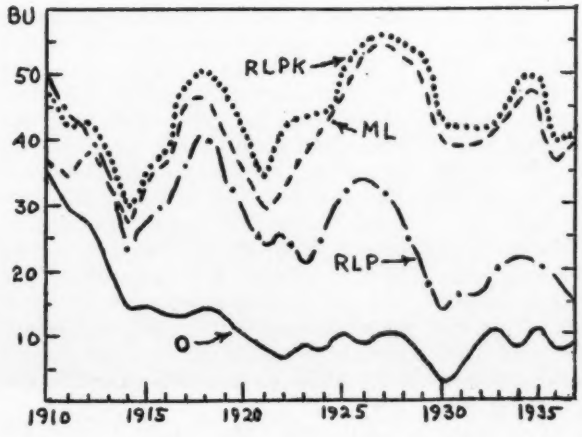
Chicago, Illinois

THE recommendation and use of more potash in fertilizer for southern Illinois are logical trends when considered from many angles. Depletion of the available potash in these acid, flat, poorly drained, gray silt loam soils has been indicated for some time by data from tests at soil experiment fields conducted by the University of Illinois.

The accompanying graph (fig. 1) shows the corn-yield trends on the Ewing Soil Experiment Field from 1910 to 1937 and indicates the rate at which potash deficiency is becoming a limiting factor. As early as 1920, about 10 years after the lime and phosphate treatments were started, the data show a distinct need for potash in the residues-limestone-phosphate system of farming. The progressive changes in experimental results are logical in the light of the present knowledge of the potash exchange complex in soils.

The State experiments show that limestone must be applied first on these soils to enable the growing of legumes, before the need for phosphate or potash becomes very evident. Potash depletion is accelerated after liming for two reasons: (1) improved legume growth causes the general yield level to rise, thus requiring more plant food per acre, and (2) increased yields deplete the available potash faster by crop removals.

Fig. 1—Corn yield trends on Ewing, Illinois, Soil Experiment Field, conducted by the University of Illinois, 1910-1937. Key: O = no treatment; L = lime; M = manure; P = rock phosphate; K = muriate of potash or kainit. (From report Ewing Soil Experiment Field, University of Illinois, July, 1938.)



Organic matter is normally very low in these light-colored silt loams. Sweet clover or other legumes, plowed down for supplying nitrogen and organic matter, improve the productive capacity in several ways. In the spring the flat fields are waterlogged. Tile drainage is not possible because of impervious subsoils, and drainage is accomplished by plowing in narrow lands, about 2 rods wide, using the dead-furrows to carry off excess water. In ad-

Fig. 2—Effect of 60 pounds of 50% muriate of potash applied in the hill. Poorland Farm, Salem, Ill., June 26, 1936.

dition to supplying nitrogen, turning under organic matter helps the moisture-control problem in two ways. First, a more porous soil drains earlier in the spring, and second, the additional humus conserves moisture for a critical dry period during the latter part of the season.

Many farmers have hit that unexpected snag — potash starvation — just when they were becoming well satisfied with the success of their lime-legume program. But they often discovered the mistake a bit too late, usually not until a severe case of potash starvation showed up on a corn crop, with the typical, brown marginal firing of the leaves, weak stalks, and low yields of poor quality corn.

Fertilizer demonstrations conducted in this territory over the past few years have shown very profitable returns from high-potash fertilizers on some farms, less profit on others. One must recall that each farm and field may represent a different level of fertility due to previous treatments, similar to the various fertility levels attained by diversely treated plots at soil experiment fields. Each farmer's problem is to determine the present stage of fertility of his soil so he may plan the next logical step.

A famous agronomic spot near Salem, Illinois, is "Poorland Farm," formerly owned by Dr. Cyril G. Hopkins of the University of Illinois and now operated by W. A. Hunter. Certain fields on this farm have developed severe cases of potash hunger on corn, wheat, soybeans, and sweet clover, following a lime-legume-phosphate cropping system. Some of the results from fertilizers are shown in the accompanying data and photographs (figs. 2, 3, 4).

"Poorland Farm" was purchased by Dr. Hopkins in 1903 at $20 per acre, in order to show what could be done with these gray silt loams on tight clay. He successfully demonstrated for several years that by the use of limestone, sweet clover, and phosphates, these soils would produce satisfactory yields of corn and wheat. However, during the last several rotations the diminishing supply of available potash cut the yields of crops severely.

Potash Increased Yield

The need for potash became apparent first on the corn crops. One of the first of the recent trials with potash was in the dry year of 1936. (See fig. 2.) Only 60 pounds of 50% muriate of potash per acre in the hill made the difference between very little corn and a fair yield of silage corn. In 1937, 125 pounds of 0-8-24 fertilizer increased the yield from 22.1 bushels to 54.8 bushels, and improved the quality. The accompanying photo (fig. 3) was taken in 1938 when 100 pounds of 0-8-24 raised the yield from 20.1 to 60.9 bushels per acre, increased the marketable corn from 80.3 to 92.8 per cent, and increased the percentage of erect stalks even following severe winds. These extreme increases from high-potash fertilizers are possible only where the available potash is very low.

Although wheat usually requires less

potash than corn, on "Poorland Farm," potash deficiency has been responsible for much poor quality wheat. In a fertilizer trial in 1938, 10 per cent extra potash made the difference shown in fig. 4, increasing the strength of straw, the total yields, and the test weight per bushel.

On still another part of "Poorland Farm" a whole field showed potash starvation. Sweet clover is usually considered a "good feeder," a crop which can extract from a fairly unfertile soil sufficient potash for its needs. Its ability to gather phosphates and potash from the soil, along with nitrogen from the air, and making these plant foods available to the following crops, is one reason why sweet clover makes such an excellent soil-improving crop. So when the potash gets so low that sweet clover starves, the supply must be very low. It was probably this ability of sweet clover to "mine" potash from the soil, to be taken up by ensuing crops of corn, wheat, or soybeans, which eventually brought the potash supply of "Poorland Farm" soils to such a low stage.

On many other farms in the territory potash-containing fertilizers proved their worth in 1938. At the W. G. Emmerick farm near Wheeler, Illinois, the 0-20-20 plot looked best early in the season, but 100 pounds of 0-8-24 gave the maximum yield of 57 bushels per acre, an increase of 25 bushels of corn with 11.7 per cent more marketable corn, and 30 per cent less down or leaning stalks. On Florent Cohorst's field nearby, 100 pounds of 0-20-20 increased the yield from about 52.6 to 70.5 bushels per acre, with 4 per cent more marketable corn and 18 per cent more erect plants.

Each Field Responded

A 125-pound application of 0-12-12 netted Carl Shurtz near Waltonville, Illinois, 10 bushels of extra corn per acre, even though he had less than half a stand of corn, due to seed germination difficulties. Edward Lacey of Kinmundy broadcast 100 pounds of 50% muriate of potash before planting his corn, and received 9.9 bushels more corn per acre, with 4 per cent more marketable corn and 15 per cent less lodged stalks. This was on a field far from the barn and received little manure.

On another field Mr. Lacey had cooperated on a wheat fertilization trial.

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Fig. 3—No fertilizer, 20.1 bushels; 100 pounds 0-8-24, 60.9 bushels. Poorland Farm, Salem, Ill., Oct. 20, 1938.

Good Grass Eases A Farmer's Work

By Franklin P. Ferguson

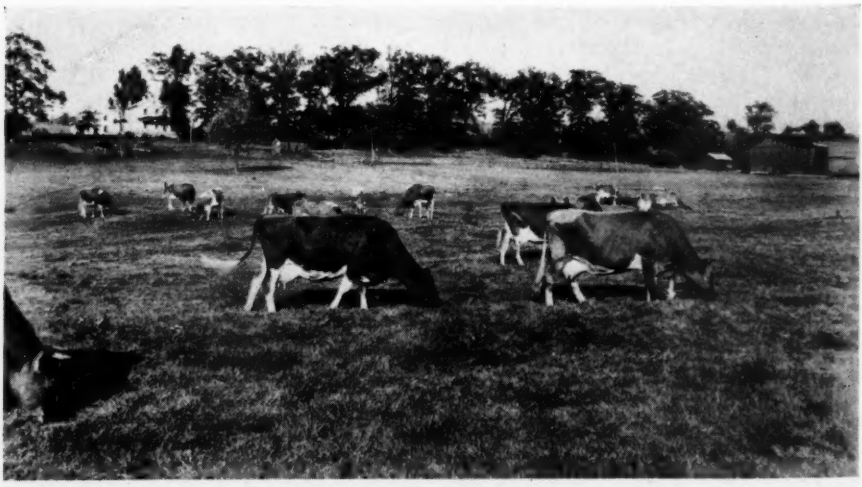
Pennsylvania Agricultural Extension Service, State College, Pennsylvania

NO SENSIBLE farmer who has a piece of land in thrifty sod ever would think of plowing it up to grow other crops unless he seriously felt the need of exercise, according to J. W. White, soils technologist of the Pennsylvania State College. And if the farmer happens to have an indolent feeling coupled with a desire for a greater income, the thing for him to do is to seed part of his cropland to grass. While the use of grain rotations and ensilage feeding should not be discouraged, he emphasizes, the economy of grazing should not be minimized.

To produce a 4-year rotation yielding 61 bushels of corn, 3,166 pounds of stover, 33.3 bushels of oats, 28.3 bushels of wheat, and 3,200 pounds of hay on a 4-acre field, 226 hours of man and horse labor are required at a cost of $59.61, but the same 4 acres can be maintained in pasture after the grass is established with not more than 8 hours of man labor costing $2.80.

While the labor spent on the pasture is much less than that spent on the rotation, a greater amount of total digestible nutrients is produced from each acre of grass, and this rule applies pretty generally to the whole of Pennsylvania. Total digestible nutrients is a scientific way of saying "feed," this high-sounding term being just as simple as a "stack of hay," but somewhat more exact. Digestible crude protein, another term favored by scientific livestock feeders, refers to the chemical constituent most often wanting in farm-grown feed supplies.

On the basis of the yields indicated for the aforementioned 4 acres, 765



Once a farmer has a thrifty stand of grass established, he can turn his livestock out to do the work of harvesting the crop for him. Ray Shook's Guernsey herd of Clarion County, Pennsylvania, seems to be doing a satisfactory job on improved pasture.

pounds of digestible crude protein and 8,407 pounds of total digestible nutrients would be produced in the grain rotation exclusive of the oats and wheat straw. These figures are offered because they represent the average production disclosed by Professor White in tests covering a long period of years on Dekalb, Volusia, and Westmoreland soils, the three most common types in the State. On the same basis, where complete fertilizers were used, 1,984 pounds of crude protein and 8,536 pounds of total digestible nutrients would be produced on 4 acres of pasture, the grass supplying almost three times as much digestible crude protein as the field crops.

Calculated on the basis of these figures, the labor cost necessary to grow a ton of digestible crude protein would be $178.22 for the rotation and $2.82 for the pasture. In like manner, a ton of digestible nutrients would involve a labor cost of $15.94 for the rotation

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POUNDS PER ACRE OF DIGESTIBLE NUTRIENTS PRODUCED ON A KENTUCKY BLUEGRASS PASTURE COMPARED WITH AN EQUAL AREA IN A FOUR-YEAR GRAIN ROTATION OF CORN, OATS, WHEAT, AND MIXED HAY

Average Results on Dekalb, Volusia, and Westmoreland Soils

	Soil Treatment			
	L+P	L+PK	L+PKN	Average
Total Field Weight of Crops—Rotation	2,721	3,615	3,909	3,415
Total Field Weight—Pasture	2,307	2,763	3,992	3,021
Total Digestible Crude Protein—Rotation	112	151	159	141
Digestible Crude Protein (excluding wheat and straw)	91	121	125	112
Total Digestible Crude Protein—Pasture	212	344	496	351
Total Digestible Nutrients—Rotation	1,335	1,783	1,929	1,682
Total Digestible Nutrients (excluding wheat and straw)	891	1,209	1,248	1,116
Total Digestible Nutrients—Pasture	1,233	1,477	2,134	1,615

An acre of Pennsylvania sod will produce more digestible nutrients (feed) annually than an acre of land in an ordinary grain rotation at a fraction of the labor cost. Walter P. Smith, Juniata County, Pennsylvania, is getting a piece of land ready for sowing.

There Is No Substitute for Soil Fertility

By William A. Albrecht

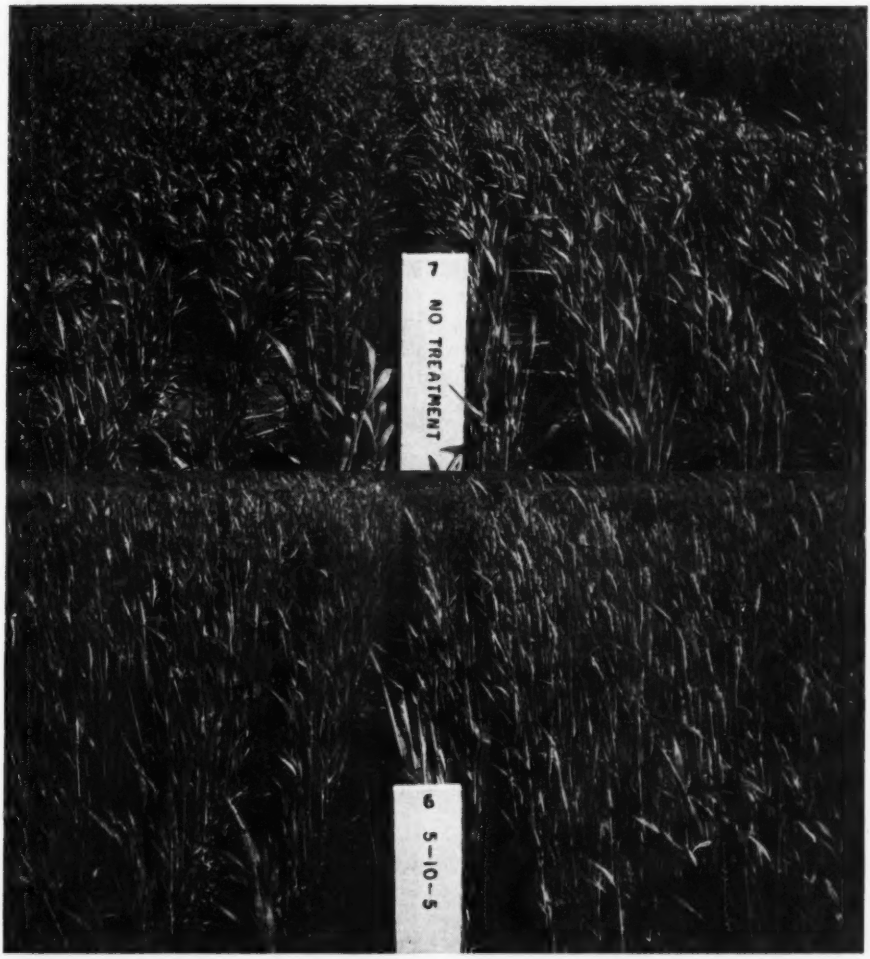
Missouri College of Agriculture, Columbia, Missouri

CROP growth depends on the usable stock of plant nutrients in the soil, or on that made available during the growing season. Crop rotations represent good soil management because they lessen the rate of plant nutrient depletion from the soil. Legume crops and grass sod covers are considered particularly effective in this respect because of the slower rate of soil nitrogen exhaustion in the former and because of the partial return of the nutrients to the field as animal droppings in the latter. Considered then purely from the crop-combination viewpoint, one can readily reason that any approach toward constant legumes or constant grass cover will approach satisfaction in terms of lessened soil depletion.

The short rotations of the cereals with newer legumes and the lessened soil tillage that have become popular in Missouri are built, in part, on this reasoning. A barley-lespedeza combination is 50 per cent legume, for example. Their satisfaction, however, is not in the crop combination without soil treatment. It must take into consideration the facts, (a) that a soil is being exhausted by any crop order or arrangement under soil management that disregards fertility return; (b) that legumes are ravenous consumers of calcium, magnesium, phosphorus, potassium, and others; (c) that they are nitrogen fixers rather than only soil nitrogen consumers when generously supplied with calcium and the other essential soil bases; and (d) that grass sod or non-leguminous crops, as well as legumes, are becoming less effective for their own preservation, or for forage feed production under increasing soil acidity, or, rather, base deficiency. In our present desire for more sod cover and more legumes, especially those growing on less fertile soils where we are expecting them to demonstrate their soil-saving results, we may well recognize many soils too low in calcium, phosphorus, and other nutrients before these crops can get even a "toe hold" in rejuvenating effects on the land.

Rotation Is Not Enough

The short rotation combinations of the cereals, barley or wheat with the more popular legumes, such as soybeans, Korean lespedeza, or possibly sweet clover, have been recently adopted for their soil cover value and their pasture extension over the main portion of the calendar. Their provocation of discussion of the subject of rotations has brought with it a recognition of the need for fitting crops to the fertility of the soil as well as into a particular rotation, or crop sequence. Soil fertility depletion has brought us to wheat and barley, in the place of oats, as nurse crops for legumes. This is true because the former two draw much of their needed nutrient supply in their young growth in the fall of the preceding year and lessen competition with the young legume during its first and the cereal harvest year. The oats are the poorer nurse crop, because they "get there first," so far as fertility is concerned, in the same season as the



Fertilizer reflects its effects on barley by earlier maturity, better quality, and larger grain yields. The plot shown at the top was not fertilized, the plot at the bottom received applications of a 5-10-5 fertilizer.

legume. They stay on well into the summer and make it difficult for legumes to succeed in the soil already sapped before they get underway at their delayed and possibly dry season. This shift to nurse crops that get off the land early is acceptance of the evidence of crop competition for a fertility that is getting too low to support both crops at the same time. It commonly places the blame on factors other than the soil, such as the seed or the season. The same declining fertility that has been too low for two crops at the same time has not only been obliterating the legume completely, but has also been lessening the productivity of the cereal, or non-legume, crop itself.

Fertilizers have been recognized as a serious need for the cereals. Superphosphate on wheat has been a safe investment in most parts of Missouri and has extended its effectiveness by establishing the legume nursed by the wheat. Now that drilling fine limestone with the wheat for clover the next spring shows liming beneficial on the wheat in the fall, as well as on the clover the

succeeding year, we may remind ourselves that superphosphate of the past contained so much calcium that this element was perhaps doing much of the benefit for which phosphorus was getting the entire credit.

The graminiae, or grass family, on many of our soils respond to the calcium in limestone more than anticipated. Oats reflect the effects of lime additions in their growth, and even corn demonstrates the influence. Limestone serves to mobilize the nutrients into the plant. Fertilizers alone on corn mobilized phosphorus into the crop only one-third as effectively as when used in conjunction with limestone, according to chemical studies of the crop.

Parallel with the increase of phosphorus went an increase of calcium in the fodder crop. Barley, used extensively in conjunction with lespedeza, also reflects the beneficial influence of the phosphate and limestone treatments. Its earliness makes it the best of all nurse crops to draw its fertility the preceding season and leave a liberal supply for the lespedeza after the barley harvest. These cereal crops reflect the effects, particularly in composition of their forage, of the lime and phosphates to remind us that, in arranging rotations, the fertility of the soil may be a factor to determine the crop efficiency as well as the crop choice. They tell us that we cannot escape the fertility shortage by offering substitute crops.

Legumes Need Fertilizers

Fertilizers for the legume in the rotation tell the same story as for the cereals, only with more emphasis. In our search for legumes which manage to grow on thinner soils, those so found must do so at a lower rate of fertility consumption by giving correspondingly lower yield rates, or smaller offering in the lower concentration of feed nutrients in the forage. Of course, lowered levels in all these are still better than complete crop failure.

Less calcium concentration in the legumes because of its depletion from the soil means less phosphorus mobilized into the plant. It means lowered concentration of protein in the forage, the tonnage yield of which means less protein yield per acre. So when these legumes make tons, it is well to appreciate the need for some test by which we can learn whether they are rich enough in such ash constituents as lime, phosphorus, potassium and others, or whether they are giving protein and items that do more than merely distend the consuming animals' paunch.

Maintaining Feeding Value

Declining soil fertility is reflected in natural vegetation by lowered yields within the same plant kind, or its disappearance and the incidence of such other kinds as can grow by using less nutrients from the soil. Such as make their advent into—and maintain themselves in—the ecological array at the lowest soil fertility level may be expected to be of low concentration in protein and ash. They must then be of low feed value as suggested by their refusal as forage by wild animals. The declining calcium, in particular, in conjunction with a moderately constant potassium level suggests the shift from the proteinaceous to woody plant composition even within the legumes. The same is indicated for the non-legumes to the point where wood production by trees may represent the extreme in calcium reduction in the calcium-potassium ratio. Naturally such also represents the lowest feed value as forage.

In disregarding soil fertility decline, represented by the large calcium depletion to give a narrowed calcium-potassium ratio, we are in danger of accepting forages of lower protein and lower mineral content irrespective of the crop combination into rotation schemes. Crops in short rotations, like any others, respond to soil treatments and are no escape from the facts that soil treatments can be beneficial to them.

PICTORIAL

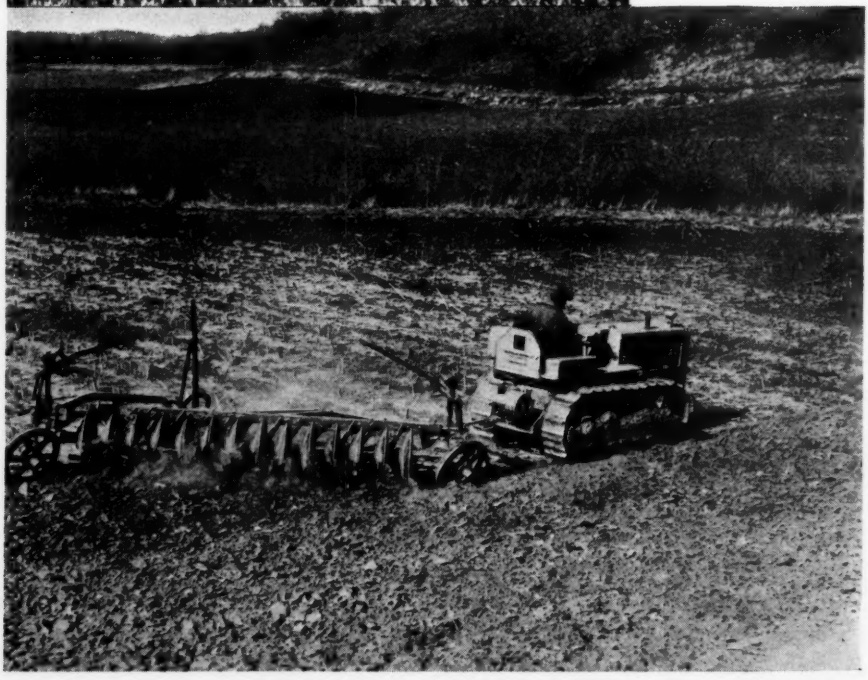
BOTTOMS UP!

The little fellows always get the hardest end of the deal.

The range of young men's "fancies" include work and play.

Left: A "wheat horizon" in the Midwest.

Below: Modern equipment speeds up spring work.



The Editors Talk

We Are Changing Our Diet

Statistical reports show that the public is becoming vitamin conscious. Important shifts are taking place in our national diet. Among such changes is an increase in the consumption of citrus fruit. According to O. E. Baker and A. B. Genung of the Bureau of Agricultural Economics in U. S. Department of Agriculture Miscellaneous Publication No. 267, "A Graphic Summary of Farm Crops," March 1938, the consumption of citrus has increased from about 10 pounds annually at the beginning of the century to more than 40 pounds, on the average, during the last 5 years. This is in comparison with a per capita consumption of about 60 pounds of apples during the last decade, which is a decrease from between 70 to 120 pounds a year during the pre-war years, varying with the season. Thus we still eat more apples than citrus, but the citrus consumption is increasing.

The reason for this is that apparently the marketing organization for citrus fruit has kept the market continually supplied throughout the year and has made the public aware of the vitamin content and other advantages of citrus fruit. The per capita consumption of oranges has increased fourfold in the third of a century, and of grapefruit from almost nothing to nearly 10 pounds. Consumption of grapes and prunes has also increased, while the per capita consumption of peaches has remained more or less stationary, except for fluctuations from year to year.

We are eating a lot more lettuce, spinach, and other green leafy vegetables. The authors estimate that between 1920 and 1930 there was an increase of 350 per cent in carlot lettuce shipments and a 240 per cent increase in the shipments of spinach. Carlot shipments of carrots increased 670 per cent during the decade; string beans 540 per cent; celery 180 per cent; cauliflower 160 per cent; but cabbage only 9 per cent.

"Totaling all vegetable shipments, except potatoes and sweet potatoes, it appears that there has been an increase during the decade of about 100 per cent. Recalling the 27 per cent increase in urban population, it appears that consumption of the vegetables per person in the cities increased around 60 per cent. But for the leafy vegetables the increase in consumption per person was about 120 per cent."

While this is a move in the right direction, it is still doubtless true that the population as a whole does not yet eat enough citrus, apples, fruits in general, or green leafy vegetables. It is to be hoped, therefore, that this trend will continue.

In line with this shift in the national diet, more and more attention by agricultural authorities all over the country is being given to the economical production of quality fruits and vegetables. Many States and Provinces in Canada now maintain experiment stations, with highly trained staffs, devoted exclusively to vegetable and fruit production. Many of the stations are nationally known for con-

tributions in solving the problems of such production. New stations are being established, and new and more intensive lines of work are being undertaken.

Prominent among such problems is the proper nutrition of vegetable and fruit crops. On all too many soils plant evidences of nutrient deficiencies are being noted in the crops grown. Such deficiency symptoms include potassium, phosphorus, boron, manganese, iron, zinc, copper and magnesium. But as a result of patient experimental and research work, the nutrition of crops is becoming much better understood. This information passed on to the farmer and the fertilizer trade is encouraging the use of fertilizers better fitted to meet the needs of soils for the production of high yield and good quality crops.

Fundamental to the health and well-being of the nation is the research of highly specialized truck and fruit stations all over the country. Such work deserves all the financial support that can be given it.

J. G. Lipman

The sympathy of national and international scientific circles is being extended the State of New Jersey in its great loss occasioned by the passing of Dr. Jacob Goodale Lipman, April 19. On leave of absence from his arduous duties as dean of the New Jersey College of Agriculture and director of the State Agricultural Experiment Station, Dr. Lipman's health had shown gradual improvement since early March until he suffered the fatal heart attack in his sleep.

Dr. Lipman's long and unselfish interest in the scientific principles underlying agriculture and his untiring efforts to bring them into effect for the betterment of the world are a matter of record. After his schooling, he was called upon in 1901 to organize at Rutgers a department of soil chemistry and bacteriology, the first of its kind in the country. The next decade saw the name of Lipman gain ever-widening prominence.

Clinging steadfastly and with extraordinary foresight to the highest ideals of public service which he felt were in the interest of consumers as well as farmers, Dr. Lipman gathered around him a capable staff to whom he gave a free hand to pursue their various lines of work. Meanwhile, he gave unstintingly of his time to public service in an ever-broadening field. Honors were heaped upon him not only as an agriculturist but also as a humanitarian. He was sent to Europe as an American delegate to the World's Dairy Congress, the International Institute of Agronomy, the International Congress of Soil Science, of which he was one of the organizers and first president, and similar gatherings.

Columbia University awarded him the Chandler Chemistry Medal in 1934 for his contributions to agricultural chemistry. He was founder and editor of "Soil Science," contributing editor of technical publications in many lands, and an honorary member of the National Academies of Sweden, Czechoslovakia, Italy, and France. Dr. Lipman served a term as president of the Association of Land Grant Colleges and Universities, collaborated on the President's Science Advisory Board, National Resources Board, Rural Resettlement Administration and Soil Conservation Service. He served in important capacities on many of New Jersey's welfare and scientific organizations.

Among the tributes being paid, in which we and our readers can sincerely concur, are those of Secretary Henry A. Wallace, "Agricultural science and education throughout the world suffer a heavy loss in the death of Dean Lipman," and of James T. Jardine, "The death of Dr. Lipman removes an outstanding personality in the administration of experimental research as well as in the development of American agriculture through education and extension. . . . His leadership has been unique and substantial."

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

¶ Of the small fruits grown in Canada the strawberry is most important because of its wide range of adaptability. According to Dominion Horticulturist M. B. Davis, et al., in Dominion of Canada Department of Agriculture publication 621, Farmer's Bulletin 63, "The Strawberry and its Cultivation in Canada," recent census returns on production and value by Provinces indicate a widespread distribution of this cultivated fruit from coast to coast. Strawberry production is popular not only from a commercial standpoint, but it is especially desirable for the home garden in parts of Canada where it is difficult to grow many edible fruits.

A thoroughgoing discussion of the principal phases of strawberry culture and also information on the common strawberry insects and diseases with proper control measures is given in the above publication. Among the problems clarified is that of faulty nutrition. Several colored plates portraying foliage symptoms of deficiencies of nitrogen, phosphorus, and potash accompany the descriptions of plant symptoms which aid in the identification of nutritional disorders. These depict the autumn tints that indicate the fertilizer requirements. The publication informs the reader that it is seldom one cannot find a few tinted leaves in late summer or early fall, but these should not cause worry unless very prevalent and accompanied by poor growth.

Since the crop ordinarily occupies the land at least two seasons, it is rather exacting in its requirements for humus, which is important for the retention of moisture and the liberation of plant food. Humus is supplied by green manure crops and manure. The authors state that where manure is difficult to procure it is possible to maintain both the humus and plant-food content of the soil by the use of green manure crops and fertilizers.

Fertilizer recommendations that have a broad application may consist of 20 to 25 tons of barnyard manure applied at least a year ahead of planting, supplemented with 200 to 250 pounds of 4-8-10 per acre. Two applications of nitrate of soda or its equivalent should be applied to the plants late in August or early September. If manure is not available, the green manure crop should be supplemented with from 200 to 250 pounds of muriate of potash and 300 to 400 pounds of superphosphate per acre broadcast before planting. Some form of nitrogen may be used a month after planting with the main application given in the early fall. The 4-8-10 analysis at the rate of 600 to 800 pounds per acre may be applied just before planting where liberal amounts of manure are not available.

Other cultural practices, such as preparation of the soil, planting, care of the young and renewing old plantations, selecting varieties, etc., are given.

"Basic Slag as a Source of Phosphorus and Calcium for Louisiana Soils," Agr. Ext. Serv., University, La., Ext. Cir. 176, Sept. 1938, R. A. Watson.

"Commercial Fertilizers, Commercial Feeds, and Agricultural Liming Materials," Agr. Exp. Sta., State Inspec. Serv., College Park, Md., Control Series, No. 169, Jan. 1939.

"Fertilizer Recommendations for 1939-40," Agr. Ext. Serv., East Lansing, Mich., Ext. Bul. 159, Feb. 1939.

"A Summary of Nitrogen, Phosphorus, and Potash Experiments in the Yazoo-Mississippi Delta," Agr. Exp. Sta., State College, Miss., Service Sh. 262, Jan. 5, 1939.

"Fruit Notes," Agr. Ext. Serv., Burlington, Vt., Jan. 9 and 30, 1939.

Soils

¶ Soil fertility investigations in Pennsylvania until 1916 were confined largely to the well-known Jordan Soil Fertility Plots at State College, which were originally laid out in 1881. Located on Hagerstown soil, these extensive investigations were applicable to the most fertile crop land of the State typical of a comparatively small area in the limestone valley sections. In order to obtain pertinent data on the soil fertility requirements of soils representative of large areas of less fertile farmland, the Pennsylvania Agricultural Experiment Station established a series of outlying experiments in 1916 on what is termed the Dekalb soil near the mountain town of Snow Shoe, with a similar plan of investigation to that pursued on the Jordan series.

A comprehensive discussion of the results obtained from 20 years' study at Snow Shoe is given in Station Bulletin 370, entitled "Fertility Studies on Dekalb Soil and Their Application to Farmland in Pennsylvania," by J. W. White, F. J. Holben, C. D. Jeffries, and A. C. Richer. Important conclusions pertaining to the application of these findings are provided in the bulletin. These refer to the comparative values of different forms and amounts of commercial fertilizers, lime, and manure in the production of crops in a 4-year rotation of corn, oats, wheat, and hay, and the most economical soil treatment for the development and maintenance of a permanent Kentucky bluegrass pasture.

The Dekalb soil group comprises 43.7 per cent of the entire State land area. The area under study at Snow Shoe is representative of the most depleted crop land found in Pennsylvania. According to the data secured from these investigations, continuous cropping without returning sufficient plant food is the logical explanation for the extreme poverty exemplified by the Snow Shoe type of farming. Results of this work emphasize that this soil when properly limed and fertilized is capable of profitable crop production comparable with the average yields of the State. It is stated that "sub-marginal" farming rather than sub-marginal land is mostly responsible for the low rating of this land.

Because of severe winter-killing of wheat on this soil, a rotation of oats or spring barley, mixed clover and timothy, and corn is recommended rather than the 4-year grain rotation. On the best phase of Dekalb in the south central and southern sections, the 4-year grain rotation may be followed. Lime, fertilizer, and manure are necessary for best results on these crops and also in establishing pastures. Detailed recommendations for fertilizing under different conditions are given.

A large area of the Dekalb soils group is devoted to pasture, and the authors give considerable attention to pasture fertilization. The relative crop-producing values of P, K, and N for the pasture investigations were found to be: P, 60; K, 20; and N, 20.

The total estimated value of corn, oats, wheat, and mixed hay produced annually on the Dekalb crop land of the State is $19,808,878. On the basis of the yields secured at Snow Shoe, the systematic use of commercial fertilizers, agricultural lime, and utilization of animal manure, if applied to the four crops studied, would raise the estimated value to $27,393,509, or an increase of 38 per cent.

"The Water-culture Method for Growing Plants Without Soil," Agr. Exp. Sta., Berkeley, Calif., Cir. 347, Dec. 1938, D. R. Hoagland and D. L. Arnon.

"Lime and Gypsum in Agriculture," Dept. of Agr., British Columbia, Canada, Sten. Cir. 16, Oct. 1938.

"The Sand Culture of Seedlings and Mature Plants," Agr. Exp. Sta., New Haven, Conn., Cir. 129, Feb. 1939, A. A. Dunlap.

"Soil Tests for Need of Lime and Phos-

phate," Agr. Ext. Serv., Lexington, Ky., June 1938, P. E. Karraker.

"Rapid Soil Tests," Agr. Ext. Serv., Lexington, Ky., June 1938, P. E. Karraker.

"Terracing with Copeland's Soil Erosion Index System," Agr. Ext. Serv., State College, Miss., Ext. Bul. 101, Nov. 1938, J. T. Copeland and L. O. Palmer.

"Soil Survey, Allen County, Kansas," U. S. D. A., Washington, D. C., Series 1935, No. 2, Nov. 1938, W. I. Watkins, W. H. Metzger, and J. R. Latta.

"Soil Survey of Hayes County, Nebraska," U. S. D. A., Washington, D. C., Series 1934, No. 11, Nov. 1938, L. A. Brown.

"Soil Survey, Carteret County, North Carolina," U. S. D. A., Washington, D. C., Series 1935, No. 3, Nov. 1938, S. O. Perkins, M. W. Beck, E. F. Goldston, J. A. Sutton, and William Gettys.

"Soil Survey, Franklin County, Pennsylvania," U. S. D. A., Washington, D. C., Series 1932, No. 31, Nov. 1938, Howard William Higbee, R. R. Finley, R. S. Long, and J. C. Bryant.

"Soil Survey, Williamson County, Texas," U. S. D. A., Washington, D. C., Series 1934, No. 10, Nov. 1938, E. H. Templin, A. H. Bean, J. W. Huckabee, Jr., Leslie H. Smith, and M. H. Layton.

Crops

¶ E. C. Westbrook, in Extension Bulletin 469 entitled "Cotton Culture in Georgia," presents the "A-B-C's" of growing Georgia's basic agricultural crop. Written in popular style, this very practical publication gives complete information on cotton production from soil preparation and planting to the time the crop is stored and marketed. Many appropriate illustrations add a great deal to the subjects discussed.

Georgia is noted for many important crops, but the annual average cash income from cotton alone is more than the combined annual cash income from all other crops produced in the State, including livestock. The author stresses the fact, however, that the income from a few acres of cotton, regardless of yield, will not be sufficient to support the farm or farm family. Cotton has an important place in the scheme of farming operations in this State, but no farmer can afford to depend upon this one crop as the sole source of cash income.

To grow cotton profitably it has become increasingly necessary to obtain high acre yields which lower the production cost per pound. The yield must be produced at a reasonable unit cost. This means the selection of land best suited to cotton, judicious use of fertilizer, planting of adapted varieties of pure seed, good soil management, an intelligent fight against insect pests, and the efficient use of labor and equipment. The purpose of this bulletin is, therefore, to help Georgia farmers produce better quality cotton at a low cost of production. The publication brings together in a single volume a summary of years of experience gained by the experiment stations, agricultural colleges, extension specialists, and successful farmers in the never-ceasing effort to make cotton production more profitable.

"A Study of the Oat Nematode," Ontario Dept. of Agr., Toronto, Ontario, Canada, J. Laughland.

"Division of Illustration Stations, Progress Report 1934 to 1937, Part 1, Prince Edward Island, Nova Scotia, New Brunswick, Quebec, and Ontario," Dept. of Agr., Dom. of Canada, J. C. Moynan.

Cereal fertilizer test plots, University of Missouri, South Farms, Missouri.

"Mushroom Culture," Dept. of Agr., Dom. of Canada, Pub. 638, Cir. 139, Dec. 1938, H. T. Güssow.

"Colorado Farm Bulletin," Agr. Exp. Sta., Fort Collins, Colo., Vol. 1, No. 1, Jan.-March 1939.

"Golden Anniversary Report for the Fiscal Year Ending June 30, 1938," Agr. Exp. Sta., Gainesville, Fla.

"Papaya Production on Oahu," Agr. Ext. Serv., Univ. of Hawaii, Honolulu, Hawaii, Ext. Cir. 2, Feb. 1939.

"1938 Iowa Corn Yield Test," Agr. Exp. Sta., Ames, Iowa, Bul. 379, Feb. 1939, Marcus S. Zuber and Joe L. Robinson.

"Ninth Biennial Report of the Director, Fiftieth Anniversary Issue for the Biennium July 1, 1936 to June 30, 1938," Agr. Exp. Sta., Manhattan, Kan., 1938.

"Kentucky Fruit Notes," Agr. Exp. Sta., Lexington, Ky., Vol. 1, No. 7, March 1939.

"Production of Easter Lily Bulbs in Louisiana," Agr. Exp. Sta., University, La., Cir. 22, Jan. 1939, Fred D. Cockran and D. L. Gill.

"Bur Clover, a Popular Winter Legume in Louisiana," Agr. Exp. Serv., University, La., Ext. Cir., 175, Oct. 1938, R. A. Wasson.

"The Fifty-first Annual Report of the University of Maryland Agricultural Experiment Station 1937-38," Agr. Exp. Sta., College Park, Md., Vol. 51, 1937-38.

"Fruit Notes," Agr. Ext. Serv., Amherst, Mass., Nov. and Dec. 1938, Jan. and Feb. 1939, W. H. Thies.

"The Massachusetts Commercial Vegetable Grower," Agr. Ext. Serv., Amherst, Mass., Jan. 1939.

"The Quarterly Bulletin," Agr. Exp. Sta., East Lansing, Mich., Vol. 21, No. 3, Feb. 1939.

"A Resurvey of the Demonstration Prairie Shelterbelts in Minnesota," Agr. Exp. Stat., St. Paul, Minn., Bul. 337, Dec. 1938, Henry L. Hansen and Henry Schmitz.

"A Compilation of Information on Kudzu," Agr. Exp. Sta., State College, Miss., Bul. 326, Jan. 1939, I. E. Miles and E. E. Gross.

"Mississippi Farm Research," Agr. Exp. Sta., State College, Miss., Vol. 2, No. 3, March 15, 1939.

"The Agricultural Extension Service, Missouri College of Agriculture; Annual Report for 1938," Agr. Ext. Serv., Columbia, Mo., Cir. 400, Feb. 1939.

"List of Publications," Cornell Univ. Agr. Ext. Serv., Ithaca, N. Y., Bulletin. 47, Revised Feb. 1939.

"Bimonthly Bulletin," Agr. Exp. Sta., Fargo, N. Dak., Vol. 1, No. 4, March 1939.

"51st Annual Report of the Pennsylvania Agricultural Experiment Station for the Fiscal Year Ended June 30, 1938," Agr. Exp. Sta., State College, Pa., Bul. 367, Oct. 1938.

"Fifty-first Annual Report of the South Carolina Experiment Station of Clemson Agricultural College, for the Year Ended June 30, 1938," Agr. Exp. Sta., Clemson, S. C., Dec. 1938.

"Making High Quality Hay," Agr. Ext. Serv., Knoxville, Tenn., Ext. Pub. 216, Jan. 1939, H. E. Hendricks.

"Pointers for the Small Orchardist," Agr. Ext. Serv., Knoxville, Tenn., Pub. 150, Jan. 1939, W. C. Pelton.

"A Pasture Program for Tennessee Farms," Agr. Ext. Serv., Knoxville, Tenn., Pub. 217, Jan. 1939, H. E. Hendricks.

"Pasture Improvement in the Gulf Coast Prairie of Texas," Agr. Exp. Sta., College Station, Brazos County, Tex., Bul. 570, Jan. 1939, R. H. Stansel, E. B. Reynolds, J. H. Jones.

"Fiftieth Annual Report 1937," Agr. Exp. Sta., College Station, Brazos County, Tex.

"Department of Agriculture-Immigration of Virginia," Richmond, Va., Bul. 367, Feb. 1939.

"Forty-eighth Annual Report for the Fiscal Year Ended June 30, 1938," Agr. Exp. Sta., Pullman, Wash., Bul. 368, Dec. 1938.

"Vegetative Composition, Density, Grazing Capacity and Grazing Land Values in the Red Desert Area," Agr. Exp. Sta., Laramie, Wyo., Bul. 229, July 1938, A. F. Vass and Robert Lang.

"Why Fruit Trees Fail to Bear," U. S. D. A., Washington, D. C., Leaf. 172, Feb. 1939, H. P. Gould.

"Plum and Prune Growing in the Pacific States," U. S. D. A., Washington, D. C., Farmers' Bul. 1372, C. F. Kinman.

"List of Available Publications of the United States Department of Agriculture," U. S. D. A., Washington, D. C., Misc. Pub. 60, Jan. 2, 1939, Fred L. Zimmerman and Phyllis R. Read.

"Index to Publications of the U. S. Department of Agriculture 1931-1935," U. S. D. A., Washington, D. C., 1937, Mary A. Bradley.

Economics

¶ Bulletin 286, "Some Trends in Utah's Agriculture," by Walter U. Fuhriman is a rather complete presentation of the economic aspects of Utah's agriculture. Tables showing the intensity of crop and livestock production, trends in yield, size of farm, total production, acreage of crops harvested, numbers of livestock, intensity of production, prices, income, and size of farm are included. The data are illustrated with numerous interesting charts.

Beginning in 1933 there was a sharp drop in the crop acreage harvested in Utah, but since 1935 increases have occurred. However, the drop was not quite as great as in the United States as a whole, and the increase since 1934

has been greater than for the United States as a whole. Since about 1920 the numbers of beef cattle have shown a tendency to decrease. There has been a gradual decrease in the numbers of horses and mules, but the numbers of dairy cattle have increased almost steadily since 1870. Numbers of sheep have fluctuated with the cycle without much sign of a definite trend. Since 1935 the total numbers of all livestock have remained about 5 to 10% below the 1926-31 average.

The intensity of crop production increased about 15% from 1910 to 1920 then decreased about 15% during the next 10 years. During recent years the intensity of crop production has been only slightly more than in 1910. Crop yields in Utah have fluctuated rather widely, and the fluctuation seems to have been influenced mostly by the annual precipitation. In the 7-year period, 1931-1937, yields were lower than for any like period in 50 years. Since about 1926 there has been little change in the production of livestock products per animal unit. Up to that time there was a tendency to increase. There was an upward trend in the total production of crop and livestock products until the late 20's, but since 1930 the production has averaged about 14% below that of the previous 7 years. This, coupled with lower prices, has resulted in an average cash income from crops and livestock of only 60% of the 7 preceding years. In recent years there has been a definite tendency towards a reduction in the size of the average farm in Utah, which, together with the low prices for farm products, lower yields, and failure to maintain the intensity of production, has materially reduced the average cash farm income.

¶ "Fertilizer Statistics for Texas, 1926-1938" is an extremely interesting publication of the Texas Agricultural and Mechanical College, especially from the standpoint of those interested in fertilizer consumption. The Bulletin, No. 572, contains statistics of fertilizer sold in Texas from 1926 to 1938. The largest consumption for any one year was 187,215 tons in 1928-29. There was a decrease following this to 30,843 tons in 1932-33. But since 1932-33 the sales have increased to 84,938 tons in 1936-37 and in 1937-38 there was a slight decrease. The heaviest movement of fertilizers in Texas takes place in January, February, March, and April with a considerable tonnage in September. From a tabulation showing fertilizer sales by counties, it is shown that the largest consumption takes place in the northeastern part of the State. There is an interesting table showing leading grades of fertilizer sold in order of tonnage since 1926-27. In 1937-38 the six leading grades were 4-8-4, 4-12-4, 4-8-6, 6-10-7, 6-8-4, and 6-12-6. In 1926-27 only small tonnages of 4-8-6 and 6-10-7 were reported and no tonnages of 6-8-4 and 6-12-6. According to the table showing the average selling price of selected grades of fertilizers since 1926, there has been a significant decrease in the average selling price of mixed fertilizers since the middle 20's.

¶ According to the mimeographed report compiled by the Department of Agronomy of the University of Illinois, "Fertilizers Sold in Illinois in 1938," total sales of mixed goods amounted to 29,330 tons for the year ending 1938. Sales of materials amounted to 6,802 tons, making the grand total of all fertilizers sold 36,132 tons. The leading single analysis of mixed goods was 2-12-6, representing 7,784 tons or 26.5% of the total of all mixed goods. The 0-12-12 was second with about 9%; 0-8-24 third with practically 6%; 2-12-2 fourth; 2-8-16 fifth; 4-8-6 sixth; 3-12-12 seventh; 4-16-4 eighth; the total of the first eight grades represented 66% of the total tonnage of mixed goods. The 29,330 tons of mixed fertilizers sold in 1938 compared with 26,524 in 1937; 22,678 in 1936; 15,381 in 1935; and only 12,034 tons in 1934. In 1938, 81% of the mixed goods contained 20 or more units of plant food. The average analy-

sis of the 10 leading grades in 1938 was 1.9-11.6-9.2, exactly the same as in 1937 and 1936.

"State-owned Land in Arkansas," Agr. Exp. Sta., Fayetteville, Ark., Bul. 370, Jan. 1939, Orville J. Hall.

"The Agricultural Situation and Outlook, 1939," Dept. of Agr., Dominion of Canada, Nov. 1938.

"Official Results of Fertilizer Analyses for the Registration Year 1937-38," Dept. of Agr., Dominion of Canada, Ottawa, 1938.

"Soil Management and Fertilizer Recommendations," Ontario Dept. of Agr., Toronto, Ontario, Canada, Feb. 1939.

"Agricultural Program Building in Colorado," Agr. Ext. Serv., Fort Collins, Oct. 1938, Fred C. Jans.

"Consumption of Mixed Fertilizers by Counties of Florida for Month of December 1938 and January 1939, as Reported by Manufacturers," Fer. Statl. Div., Bu. of Inspec., Tallahassee, Fla., Nathan Mayo, Com.

"Consumption of Fertilizer Materials by Counties of Florida for Month of December 1938 and January 1939, as Reported by Manufacturers," Fer. Statl. Div., Bu. of Inspec., Tallahasseee, Fla., Nathan Mayo, Com.

"Illinois Farm Economics," Agr. Ext. Serv., Urbana, Ill., No. 45, Feb. 1939.

"Inspection of Agricultural Lime Products," Agr. Exp. Sta., Amherst, Mass., Control Series, Bul. 97, Dec. 1938, H. D. Haskins.

"Crop Report for Michigan," Mich. Dept. of Agr., Lansing, Mich., Jan. 1939.

"Farm Business Notes," Agr. Ext. Serv., University Farm, St. Paul, Minn., No. 195, Mar. 1939.

"Fertilizer Analyses and Registrations, 1938," Minn. Dept. of Agr., St. Paul, Minn., R. A. Trovatten, Com.

"1939 Mississippi Agricultural Outlook and Planning Guide," Agr. Ext. Serv., State College, Miss., Ext. Bul. 104, Feb. 1939.

"Montana Farm Foreclosures," Agr. Exp. Sta., Bozeman, Mont., Bul. 368, Feb. 1939, R. R. Renne.

"Analyses of Commercial Fertilizers, Fertilizer Supplies, and Home Mixtures for 1938," Agr. Exp. Sta., New Brunswick, N. J., Bul. 657, Charles S. Cathcart.

"Current Farm Economics," Agr. Exp. Sta., Stillwater, Okla., Vol. 12, No. 1, Series 49, Feb. 1939.

"County Land Management in Northwestern South Dakota," Agr. Exp. Sta., Brookings, S. D., Bul. 326, Sept. 1938, R. J. Penn and C. W. Loomer.

"A Planned Farm Program," Agr. Ext. Serv., Knoxville, Tenn., Pub. 187 (Revised), Sept. 1938.

"An Economic Study of Farm Organization and Operation in the High Plains Cotton Area of Texas," Agr. Exp. Sta., College Station, Brazos County, Tex., Bul. 568, Jan. 1939, B. H. Thibodeaux, C. A. Bonnen and A. C. Magee.

"A Study of Farm Organization by Types of Farms in Uinta Basin, Utah," Agr. Exp. Sta., Logan, Utah, Bul. 285, Jan. 1939, George T. Blanch.

"Agricultural Adjustment 1937-38," U. S. D. A., AAA, Washington, D. C., G-86, Jan. 1939.

"The Land Utilization Program for the Northern Great Plains," U. S. D. A., Washington, D. C., Northern Great Plains Region, Soil Cons. Series.

"Marketing Agreement Regulating the Handling of Oranges, Grapefruit, and Tangerines Grown in the State of Florida," U. S. D. A., AAA, Washington, D. C., Mkt. Agree. Series, Agree. 84, A-19, Feb. 22, 1939.

"Order Regulating the Handling of Oranges, Grapefruit, and Tangerines Grown in the State of Florida," U. S. D. A., Washington, D. C., O-33, Chapter IX, Part 933, Feb. 22, 1939.

"Give the Range a Chance," U. S. D. A., AAA, Washington, D. C., Reg. Inf. Series, WR Leaf. 301, Feb. 1939.

"Arizona, California, Colorado, Idaho, Kansas, Montana, Nevada, New Mexico, North Dakota, Oregon, Utah, Washington, and Wyoming Handbooks, 1939 Agricultural and Range Conservation Programs, U. S. D. A., AAA, Washington, D. C., WR-1939, Feb. 1939.

"The Tobacco Industry, a Selected List of References on the Economic Aspects of the Industry, 1932-June 1938," U. S. D. A., Washington, D. C., Ag. Ecs. Bib. 75, Sept. 1938, Louise O. Bercaw and Mary G. Lacy.

"Cost of Production of Potatoes, Data from Studies in 35 States, and in the United States by Groups of States, Selected Years, 1901-36," U. S. D. A., Washington, D. C., May 1937, R. P. Matteson and H. W. Hawthorne.

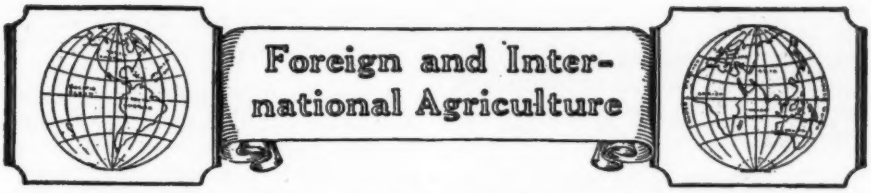
"I wants to be procrastinated at de nex' corner," said Uncle 'Rastus to the street-car conductor.

"You want to be—what?"

"Look in de dictionary, sah! 'Procrastinate, to put off.' Dat's what I mean."

The stranger laid down four aces and scooped in the pot.

"This game ain't on the level," protested Sagebrush Sam, at the same time producing a gun to lend force to his accusation. "That ain't the hand I dealt ye!"



To supply information on agricultural research in other countries, titles and a few descriptive remarks of principal articles in the two magazines "Die Ernährung der Pflanze," published in Berlin, Germany, and "La Potasse," published in Mulhouse, France, are given here. Due to space limitation, only articles of general fundamental interest are given, although both magazines contain other articles of local interest and abstracts of outstanding articles in other publications.

Die Ernährung der Pflanze, March 1939, Vol. 35, No. 3

THE EFFECT OF POTASSIUM AND THE ANIONS OF POTASH SALTS ON THE PRODUCTION OF OIL BY THE FLAX PLANT AS OBSERVED IN FIELD EXPERIMENTS. *By K. Schmalfuss, Berlin, Germany.*

Flax was grown 2 years in a moderately fertile soil, and fertilized with none, 50, and 100 pounds per acre of actual potash in the muriate and sulphate forms, in addition to nitrogen and phosphoric acid. Yield of straw was increased both years, while the seed yield was increased only in the second year. The greater effects of the potash the second year are thought to be due to depletion of the unfertilized soil by the cropping. The oil content of the seed was unaffected by the fertilization, but the amount of unsaturated fatty acids (drying agent) was consistently higher in the potash-fertilized seed. The muriate produced more unsaturated fatty acids than did the sulphate. The author states this is due to the effect of monovalentions in reducing transpiration and keeping the temperature in the plant lower than is the case when divalentions are present. Potash fertilization also reduced the nitrogen content of the seed, the author stating that this follows the general rule that potash-deficient plants are higher in nitrogen.

ON THE REMOVAL OF PLANT FOOD FROM THE SOIL BY AGAVE SISALANA. *By F. Alten and R. Gottwick, Berlin, Germany.*

Sisal was grown in the greenhouse in Berlin for 6 years, on a fertile soil, with a complete fertilizer, with fertilizer lacking potash, and with no fertilizer. The potash when used was supplied in the form of the chloride, sulphate, nitrate, and sulphate of potash-magnesia, separately in equivalent amounts. The plants developed normally under the controlled conditions, but yields were not as high as would be secured under normal conditions. The first cutting of leaves is reported here, and results show that only potash in the fertilizer increased the yield. In addition to increasing yield, the potash increased the quality of the fiber somewhat, particularly its length and tensile strength. Muriate of potash gave slightly better results than the other salts. Analysis of the harvested material showed that a yield of about 1.5 tons fiber per acre removed about 125 pounds per acre of nitrogen, 45 pounds of phosphoric acid, 200 pounds of potash, 500 pounds of lime, and 80 pounds of magnesia.

INVESTIGATIONS AND OBSERVATIONS ON THE CONTENT OF EASILY AVAILABLE POTASH IN THE SURFACE LAYERS AND SUBSOIL OF DIFFERENT SOIL TYPES. *By O. Engels, Speyer, Germany.*

The available potash content of the surface soils was usually higher than that of the subsoils. In some cases the potash in the subsoil was about the same as in the surface soil, such soils usually being sandy or sandy loam types. The author points out that the potash is absorbed by the surface layers of soil, particularly in the heavier types, thus preventing it from being washed down into the lower layers, or entirely

out of the soil. Attention is called to the fallacy of assuming that if the surface soil is well-supplied with available potash, the subsoil also would contain a sufficiency.

THE LIME-POTASH LAW AND ITS BEARING ON THE RETARDATION OF THE GROWTH OF ROSES UNDER GLASS AND IN THE OPEN. *By A. Wetzel, Berlin, Germany.*

The analysis of sickly and healthy rose plants showed little variation in composition. Determination of available nutrients in the soils on which the plants were growing revealed that the soils were only moderately well-supplied with potash and phosphoric acid in both cases, but the lime content was much higher where the plants were not growing well. It was concluded that the high lime content of the soil reduced the availability of the potash to the plant, thereby disturbing its growth and making it sickly. The trouble can be corrected by applying higher amounts of potash fertilizers to roses growing on high-lime soils. The author brings out that different varieties of roses differ in their lime requirements, although many prefer rather sweet soils.

PHOTOGRAPHIC PRESENTATION OF SEED AND FRUIT OF IMPORTANT CULTIVATED MEDICINAL, FRAGRANT AND CONDIMENT PLANTS. *By A. Pietsch, Perleberg, Germany.*

The author is compiling a comprehensive illustrated catalogue of plants pertinent to the above title. This is being published as a series in the magazine, this section dealing with plants whose aerial vegetative parts are used for drugs. In each case the common names, scientific name and family, natural distribution, useful parts of plants and products, weight per thousand seeds, number of seeds per gram, percentage and rapidity of germination, method of propagation, methods of planting, where grown, and areas are given.

THE CHARLOCK CAMPAIGN IN BAVARIA. *By F. Fürst, Germany.*

A questionnaire among farmers in Bavaria showed that most of them are troubled more or less with charlock or wild mustard. The use of dusts to control the weed is preferred to spraying, although a large number of machines for this purpose are available, frequently through cooperatives. A mixture of finely ground kainit and cyanamid has been found to be the most effective dusting material. Either alone can be used, but the mixture is better. The spraying must be done early in the life of the plant, otherwise the material simply acts as a fertilizer to the weed rather than as an eradicator. Among spray materials, raphanite and iron sulphate are the most common, but no sprays can be used in fields seeded to clover. Some other weeds also are controlled in the treatments to control the mustard.

THE ABSORPTION OF NITROGEN, PHOSPHORIC ACID, AND POTASH BY VARIOUS FIELD CROPS DURING THEIR GROWTH. *By T. B. van Itallie, Groningen, Netherlands.*

The per cent and absolute dry matter, nitrogen, phosphoric acid, and potash contents of winter and spring wheat, rye, oats, barley, beans, potatoes, and sugar beets at various periods during the growing season have been compiled by the author. During early growth, the nutrients are absorbed faster than dry matter is produced. During most of the growing period, there is no relationship between nutrient supply and per cent content in the plant, although there is a relationship with total weight in the plant. A large nutrient supply during the latter period of growth results in a tendency for the plants to take up more than normal amounts, so that the maximum absorption is reached earlier than normal. This results in a negative absorption toward maturity. The courses of absorption of the separate nutrients for the several plants

studied are discussed briefly in this abstract and apparently in detail in the original Dutch article.

La Potasse, February 1939, Vol. 13, No. 118

PROPAGANDA FOR BREAD IN FOREIGN COUNTRIES. *By A. Fleury, France.*

A movement is being undertaken in France to increase bread consumption in order to dispose of the large stocks of wheat accumulating there. It is stated that bread consumption has decreased 30% in France during the last 20 years. A similar campaign in England during the last 5 years is described in some detail, together with some mention of similar activities in the United States and Belgium.

PRODUCE GREEN FORAGE FOR FEED FOR YOUR CATTLE. *By L. Audidier, France.*

The freezing weather in December caused much damage to various forage crops and to silage. This is very serious since hay yields last year were low due to dry weather. To alleviate the situation, the author briefly discusses the growing of various spring-sown crops which can be used for pasture, hay, or feed. The crops mentioned are barley, vetch, gray peas, horse beans, silage corn, and millet. Seeding and fertilizer directions are given.

CHLORIDES IN THE PLANT. *By J. F. de Ferrière, Mulhouse, France.*

The work of Guérillot of Grignon on chlorine in plants is briefly reviewed. He found that in some plants, such as oats and poppy, chlorine is absorbed by the plant throughout its vegetative period, while in others, such as buckwheat and alfalfa, a maximum point in absorption is reached, after which there is a recession in the chlorine content of the plant. The chlorine content of plants varies considerably, depending on kind of plant, its age, and the chlorine present in the soil or air. Chlorine does not appear to be essential for growth, or at least in only very small quantities. The plant has a great avidity for the element, however, being able to obtain it from exceedingly low concentrations in the soil or air, and gorging itself even to the extent of toxicity if large quantities are present.

Work of Barbier of Versailles on the sulphur and chlorine contents of beets and wheat also is mentioned. He concluded that sulphur, which is essential for growth, is present in plants in relatively stable amounts, not increasing with increase in supply. This is in sharp contrast to the action with reference to chlorine mentioned above, and observed also by Barbier. He found that the increase in chlorine in the plant had a tendency to cause an increase in absorption of bases, particularly calcium. The author mentions work in England where fertilizers containing chlorine were very beneficial in their action on the yield of mangels. It is noted that this plant is closely related to a species of plant whose natural habitat is salt marshes, as a possible explanation for the beneficial action of chlorine in this case.

From all this work the author draws several practical conclusions. He recommends that where large applications of fertilizer are made, only one of the plant-food carriers be in the chloride form. In most cases, the most concentrated potash salts should be used, as they contain less chlorine per pound of potash than the raw potash salts. The raw salts should never be used in areas of low rainfall, and usually not for summer applications. They are best used in areas of high rainfall and applied well in advance to seeding. In market-gardening and floriculture, sulphate or nitrate of potash should be employed for applications made during the growing period. Sulphate of potash should be used on tobacco owing to the deleterious effects of chlorine on the burning properties of the leaf.

THE GROWING OF MANGELS WITH CLOSE PLACEMENT. *By X. de la Poype, France.*

Suggestions for growing mangels in the western region of France are given.

It is stated that the closer the plants are grown, the greater the sugar content, the higher the yield, and the less the work in controlling weeds. The methods employed by a successful grower are briefly described. A stand of about 25,000 plants per acre is obtained. To support such a heavy stand, a generous manuring and fertilization are given. About 15 tons of manure are applied and in addition, 1,100 pounds of 4-8-14 per acre at planting, followed with a top-dressing of 150 pounds per acre of nitrate of soda. Yields of roots run from 40 to 50 tons per acre, depending on weather conditions. The sugar content is over 12%.

A SOIL SAMPLING TUBE. *By J. Dulac and A. Bouat,* Montpellier, France.

The authors describe a soil sampling tube whereby representative soil samples can be taken to a depth of about 18 inches. Illustrations and detailed specifications of the tube are given.

THE FERTILIZATION OF MALTING BARLEY.

Abstract of work by Burgevin and Guillemart of France. The latter is quoted to the effect that malting barley should contain a high content of starch and a low content of nitrogen. The grain should be well-filled-out, plump, and have a tender seed coat. The plant should have grown normally, and been well-matured. Discussing the action of the nutrients, it is stated that nitrogen produces growth and yield; phosphoric acid regulates growth, gives strength to the plant, and aids in the formation and maturity of the grain; potash favors starch formation, and is important in the quality of the grain. Fertilizer for malting barley should be well balanced, a typical analysis being 3-10-12. Further recommendations on the fertilization of the crop under different systems of cropping are given.

Growers in North Turn to Seedlings Grown in South

For years large commercial vegetable growers in the North have sought a means of obtaining seedling plants of cabbage, tomatoes, eggplant, pepper, and other vegetables at a lower cost. Such plants must be early, hardy, and comparatively free from disease. While greenhouse and cold-frame production is effective, it is relatively costly and there is always a possibility of rapid spread of disease under glass.

As a result of increasing northern demand and improved rapid transportation by both train and truck, growers have turned to the use of field-grown seedlings from the southern States. These plants are both early and hardy since the seasons allow ample opportunity for growth before the time for transplanting in the North. The largest acreage devoted to such production probably is in southern Georgia, say plant specialists of the United States Department of Agriculture, although there are some extensive plantings of certain seedling crops in Florida, Mississippi, Arkansas, and Tennessee.

The major portion of the 15,000 acres of seedlings in Georgia is devoted to tomatoes and cabbage, with onions, egg-plant, and pepper as lesser crops. Most of the plants go to produce the canning crop in such States as Maryland, New Jersey, Indiana, Illinois, Ohio, and Pennsylvania.

When southern-grown plants are used so extensively in the North, the problem of disease control is important. A constantly increasing effort is being made to secure seed free from disease, and seed treatment is considered essen-

tial, particularly with tomatoes, since it almost completely controls such seed-borne diseases as bacterial canker and bacterial leaf spot and is partially effective in the case of others.

The Department of Agriculture and the State experiment stations are cooperating with southern plant growers in studies of the problems of successful seedling plant production.

Thin Lawns Usually Need Fertilizing, Not Seeding

Every spring thousands of homeowners, recalling that the lawn looked rather thin last summer, scatter seed in hopes that a dense stand of green grass will hide the bare spots.

Experience with lawns and pastures has proved to United States Department of Agriculture workers that by far the most frequent cause of thin turf is infertile soil. Grass plants usually adjust themselves to the plant food available in the lawn or pasture. When the grass cover is thin it usually is a sign that there is not enough plant food to support a dense sod. Sowing fresh seed is likely to be a waste of money and effort unless the soil is first fertilized enough to support a heavy growth of lawn grass. If the soil is made fertile enough, the sod may thicken up without additional seeding. If it lacks plant food for the plants already in place, it cannot supply enough food to the new plants with their smaller root systems.

Thin lawns or pastures usually need a complete fertilizer and in most cases benefit from an additional application of superphosphate. County agents know local needs and the fertilizers available in the local markets.

Commercial Fertilizers

Compiled information on the production and manufacture of fertilizers has been enriched by the recent appearance of the second edition of G. H. Collings' well-known and successful book "Commercial Fertilizers" (P. Blakiston's Son & Co., Inc., Philadelphia, Pa., $4.00). The first edition was considered by many to be one of the best and most up-to-date books on the subject and the second edition, while keeping the same general outline, has been revised to some extent and includes changes that have taken place in the industry during the 4 years that have elapsed between the editions. Statistical information has been supplemented with the latest information available, new tables have been added, and others have been reset in more readable type. Technological developments in production and manufacturing methods have been given consideration, and the material on the secondary or trace elements expanded. It is noticed that boron has been transferred from the chapter on non-essential to that on essential elements. Keeping abreast of the latest information on fertilizer placement, the chapter on this subject has been enlarged. A new chapter has been added dealing with soil acidity in its relationship to fertilizer usage. Many other revisions, most of them improvements, have been made throughout the book, but space does not permit going into detail here.

To those acquainted with the first edition, no further introduction to the style and scope of "Commercial Fertilizers" is needed. For others, it may be

stated that Dr. Collings has written the book primarily as a text to be used in teaching the subject of fertilizer production and use. The volume is also well suited to serve as a reference, guide, and handbook of the subject indicated by its title. The avoidance of technical details and the simple and clear explanations make the subject matter understandable to anyone with ordinary intelligence. The source, production, and manufacture of practically all important and many minor fertilizer materials, together with brief remarks on their adaptability and use, comprise the major part of the book. Other sections are devoted to information on purchasing, formulating, and applying fertilizers, and adapting them to individual soil and plant needs.

This new edition of "Commercial Fertilizers" should enjoy equal or greater popularity than its predecessor. Copiously illustrated, well printed and bound, and supplying the latest information on the subject the book is a useful addition to the literature on fertilizers.

A Champion Farmer Knows His Soil

(*From page* 10)

of Agriculture graduate and former county agricultural agent, knew his soil by fields. In describing his potato-field soil, he reports it reddish brown muck with a pH of 4.8 and low in phosphoric acid and potash. His corn land was black muck with considerable wash sand, a pH of 6.0, and medium in phosphoric acid and potash. Black muck with a pH of 5.7, medium in phosphoric acid, and low in potash was the onion land that produced for him the State championship yield. Yes, Whit knew the important things about his soil before he attempted to strengthen the weakest factors through soil treatment with fertilizers.

With this information what did he do?

On his potato land, he placed in bands on each side of the seed pieces 500 pounds of 0-10-25 fertilizer per acre. The result: "It increased the yield at least 100 bushels per acre and especially produced good cooking quality." However, he said the fertilizer on this crop in this field, according to his observations, advanced the maturity of the potatoes "probably very little."

His corn land had a crop of rye growing on it last spring that was plowed under as "green manure" when 12 inches high. Then, 150 pounds of 0-14-14 fertilizer were applied per acre in the rows. The result: "One row missed fertilizer treatment, and you could easily see the effects. Stalks (receiving fertilizer treatment) were deeper green and there was no doubt about increased yields." Whit estimated the fertilizer increased yields about 35 bushels per acre and advanced maturity about 7 days.

The onion land received 600 pounds of 0-10-25 per acre, and the fertilizer was broadcast. In addition, the land had the benefit of 100 pounds of copper sulphate per acre, which was mixed in with the fertilizer. The result: "Produced increased yields and better quality onions that were uniform in every way." The State onion champion estimated that the fertilizer increased the yield 200 bushels per acre and advanced the crop's maturity by 7 days.

For Crop Improvement

In listing the principal points of crop improvement that were used in growing each of these three prominent muck crops, Whit names proper fertilization in every case. In addition he named hybrid seed and clean shallow cultivation for corn; good seed, seed treatment, and dusting for potatoes; and good seed and use of copper sulphate for onions.

Taking a tip from Indiana's onion champ and distinguished muckland

farmer, one might conclude that to be successful on "The Promised Land" it is necessary to know the soil. And that means taking proper samples of the soil to a county agricultural agent or to the agricultural experiment station and having them tested to determine the relative potash and phosphoric acid content and the pH.

With that information at hand, the next step is to follow these recommendations in the purchase of fertilizers and other soil treatment materials. Of course, there is the final step of applying the fertilizers in the proper amounts using the proper methods. In reality, Whit balanced the rations for his muck crops by helping nature help herself. And in practice, it was just as simple as that.

Why Southern Illinois Needs More Potash

(*From page* 17)

This field, being nearer the homestead, had been pastured and manured and gave the greatest response to the phosphate in the fertilizer: no fertilizer, 15 bushels; 155 pounds of 0-20-10, 29 bushels of good quality wheat. Emil Engel, living on a neighboring farm, also had a wheat fertilization test, in which very little response was obtained from similar fertilizer applications. In this case the unfertilized areas produced 10 bushels per acre, while 160 pounds of 0-20-10 gave a maximum yield of only 12.9 bushels.

Why these seemingly erratic returns from fertilizers on the adjacent Lacey and Engel farms? The variation was no doubt due to differences in the effective nitrogen supplies in the two soils. The Lacey wheat was dark green in early spring, growing vigorously from the start, and producing straw of above average height. The Engel wheat was light green in early spring, never attained a normal green color, and was short at harvest time. On a nearby section of the Engel field which had been manured and cropped in a different way, the wheat was normal green and produced more than 20

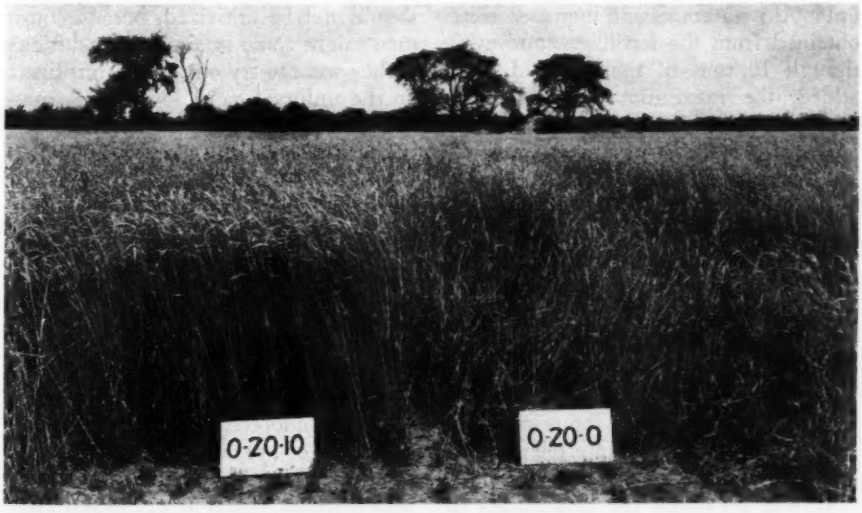


Fig. 4—Left: 160 lb. 0-20-10; yield 29.6 bu.; test weight 54.5 lb. Right: 150 lb. 0-20-0; yield 13.7 bu.; test weight 45 lb. Only 10 per cent extra potash made this extreme difference in strength of straw, total yield, and test weight per bushel. Poorland Farm, Salem, Ill., June 18, 1938.

bushels per acre. The lack of available nitrogen was a limiting factor in the Engel trial and precluded any beneficial effects of the added phosphates and potash.

Ray Marxman of Effingham, Illinois, applied a series of various analyses on each of two corn fields. On a limed soil (pH 7.0) 100 pounds of 0-20-20 increased the yield from 29 to 41.4 bushels, with a very marked case of potash starvation symptoms on the unfertilized rows. But on another field (pH 5.1) no consistent increases were obtained from the fertilizers, and even though 10 tons of manure had been added, the maximum yield obtained with any treatment was 35 bushels per acre. Both fields had been injured somewhat by hail and wind.

There were several "failures" in fertilizer trials on corn throughout the territory, even where soil tests indicated deficiencies of phosphates and potash. "Failures" should be of interest because of the challenge to determine the factors which limit yields and decrease expected effects of fertilizers. There is extreme need for research to explain many of these interrelated soil-fertility problems.

It was no doubt the deficiencies in fundamental data of soil chemistry at that time which led Dr. Cyril G. Hopkins to predict that proper farming methods would liberate potassium from Illinois soils rapidly enough to take care of crop needs. He had actually tried potash, in the form of kainit, on "Poorland Farm" and certain experimental fields, and received no definite increases in yields. Continuations of the experiments conceived and started by Dr. Hopkins are now telling a different story than they did soon after their inception.

However, Dr. Hopkins' predictions should not be criticized, because most men might come to similar conclusions if they were to try out potash fertilizers on the unlimed, acid, low-organic-matter soils. Many farmers have tried fertilizers on corn, only to be disappointed with low yields regardless of fertilizer treatment, and on soils which test medium to low in available phosphates and potash. What is the answer?

Limestone seems to be the important key required to increase the potential yielding capacity, and limestone should be advised first. It is certain that any system of soil improvement which is adopted should include the addition of phosphates and potash somewhere in the rotation. On limed soils it seems logical to advise abundant applications of phosphate-potash mixtures for the wheat or small grain for

RESULTS OF 1938 CORN FERTILIZATION TEST ON POORLAND FARM, IN COOPERATION W. A. HUNTER, SALEM, ILL.

Fertilizer Treatment	Yield per Acre Bu.	Per cent Poor Quality Corn	Per cent Down or Leaning Stalks	Value per Acre	Fertilizer Costs per Acre	Net Increase Due to Fertilizer
1. 100# 0–8–24.....	60.90	7.25	50.0	$23.46	$1.98	$14.22
2. No fertilizer.....	20.14	19.70	63.2	7.26	.....	.....
3. 100# 0–20–20.....	45.75	7.04	64.3	17.65	2.54	7.16
4. 100# 0–20–0.....	25.64	12.98	67.3	9.59	1.29	− .34
5. 150# 0–8–24.....	55.68	3.68	35.4	21.86	2.96	9.56
6. 300# 0–8–24.....	65.98	3.88	29.7	25.88	5.92	9.93
7. No fertilizer.....	27.96	8.30	65.9	10.72	.....	.....
8. 65# 0–0–50.....	51.28	3.68	53.4	20.14	1.55	9.20
9. 160# 0–0–50.....	60.64	4.16	39.5	23.75	3.82	9.87
10. No fertilizer.....	23.83	16.90	74.5	8.73	.....	.....
11. 100# 0–8–24.....	62.49	3.42	44.3	24.57	1.98	13.86

the benefit of the grain and to assure good growth of the legume. A small application of fairly high potash fertilizer for the corn should maintain yields and assure good quality. As more and more legumes are turned under for organic matter, the trend to high-potash fertilizers will be upward, since the reserves of easily replaceable potassium in the soils are naturally low.

It is a serious mistake to allow the supply of available potash or any other plant food to become so low as to permit such enormous increases from small applications of fertilizers as shown in the accompanying photographs. The unbalanced fertility conditions which make outstanding demonstrations possible are costly mistakes for the farm owners. One should start to apply proper fertilizers before the nutrients get so inadequate that deficiency symptoms appear, or that he may expect twofold increases from fertilizers. Fertilizers should be used primarily to maintain high yield levels rather than for the sake of large percentage gains on investments in plant food.

The use of soil tests for determining available nutrients and lime needs seems to be the most usable method for the early detection of declining reserves of plant food, and prescribing proper soil treatments for individual fields.

Good Grass Eases A Farmer's Work

(*From page* 19)

compared with 66 cents for the pasture.

Four acres of ensilage corn yielding 37.2 tons of green feed involve a labor cost of $106.04. Such a yield would supply 744 pounds of digestible crude protein and 9,896 pounds of total digestible nutrients. The labor cost of the protein would be $286.20 compared with $2.82 for pasture. The total digestible nutrients would be produced at a labor cost of $21.21 compared to 66 cents on the pasture.

The varying amounts of total digestible nutrients produced on Kentucky bluegrass pasture are compared in the accompanying table with the amounts grown on an equal area under a 4-year grain rotation of corn, oats, wheat, and mixed hay, lime and commercial fertilizers being applied to both the grain and pasture crops.

Cotton Fertilizer Tests

(*From page* 14)

pared to a complete fertilizer treatment.

In order to get a true picture of the situation as it actually exists, it must be reiterated that this particular soil is a fertile valley sandy soil, and that it is surrounded by hillsides which contain a great deal of calcium. The plentitude of calcium maintains a pH of 6 or above, which is favorable for phosphorus assimilation. Furthermore, the soil carries considerable active organic matter which releases large amounts of nitrogen. Consequently, the soil does not require large amounts of nitrogen and phosphorus to support a good cotton crop.

Table 3 shows the yields of a test conducted for 13 years on Lintonia silt loam, a second bottom soil in the brown loam region. The results confirm other tests conducted on similar soils of this region and show an enormous response to potash. All fertilizer treatments gave increased yields greater than 102 pounds which is necessary for significance.

Six hundred pounds of 4-8-0 yielded only 137 pounds of seed cotton per

acre more than no fertilizer. But when 2 per cent potash (12 pounds K_2O) was added to 4-8-0, the yield was increased 271 pounds per acre, a highly significant figure. When 4 per cent potash was added to 4-8-0, an increase of 465 pounds was obtained. The 4-8-6 treatment, wherein 36 pounds of K_2O were applied, continued to increase the yield of cotton to 577 pounds per acre more than was obtained with no potash.

Applications of nitrogen higher than 4 per cent, as 4-8-4, failed to produce any increase in the cotton yields. The table shows no difference between the treatments of 4-8-4, 6-8-4, and 8-8-4.

No significant difference may be attached to the treatments varying phosphorus. The 4-4-4 treatment appears as good as either the 4-6-4 or 4-8-4 treatment.

After the test had been conducted for 7 years, the heavier rates of 1,200, 1,800, and 2,400 pounds of 4-8-4 were dropped because they failed to average any better than the 600-pound treatment. The yield of these plots is not reported in Table 3.

The Lintonia silt loam had a pH of 6.6, which is within the pH range that optimum phosphorus assimilation usually occurs in the soil. Therefore, fixation of phosphorus into an insoluble form was at a minimum. Leaching of this particular nutrient, in the soil concerned, is insignificant, and being in the valley, it lost very little by erosion. The phosphorus content of the untreated soil was quite high. Consequently, great response to phosphorus applications would not be expected.

The failure of this soil to give increased yields from nitrogen is probably due to the high amount of active organic matter which serves as a very important source of nitrogen for the cotton crop.

Most of the bottom soils of Mississippi show a deficiency in potash, and the two soils studied are representative of these soils. The applications of fertilizer upon these soils were much higher than the average farmer uses and perhaps have accumulated some plant food during this period of years. Since the application is larger than that ordinarily used by farmers, the pounds of plant food applied should be considered rather than the formula of the fertilizer mixture used.

It is a matter of simple arithmetic. A 600-pound mixture of fertilizer containing 4 per cent potash has 24 pounds (expressed as K_2O); whereas, if 24 pounds of potash were applied in a 300-pound mixture, it would be 8 per cent potash. Since 300 pounds is more nearly in line with what the average

TABLE 3—YIELD OF COTTON TEST CONDUCTED ON LINTONIA SILT LOAM—1925–1938*

Fertilizer Treatment	Yield in pounds of seed cotton per acre						
	1925	1926	1927	1928	1929	1930	1931
600# 4–8–8	1,995	2,121	1,196	1,598	1,833	1,573	564
600# 4–8–6	1,877	1,971	1,089	1,603	1,699	1,410	450
600# 4–8–4	2,147	1,751	1,068	1,381	1,584	1,303	472
600# 4–8–2	1,799	1,576	1,143	1,056	1,316	1,202	390
600# 4–8–0	1,731	1,328	1,093	847	902	911	343
600# 8–8–4	1,922	1,737	1,074	1,244	1,552	1,353	406
600# 6–8–4	2,036	1,732	1,206	1,383	1,472	1,347	442
600# 4–6–4	2,032	1,586	1,109	1,319	1,449	1,317	569
600# 4–4–4	1,984	1,504	1,098	1,179	1,239	1,268	466
No fertilizer	1,561	1,213	824	786	763	714	390

Fertilizer Treatment	Yield in pounds of seed cotton per acre						13-Year Average
	1933	1934	1935	1936	1937	1938	
600# 4–8–8	1,991	1,672	1,289	1,756	2,188	2,011	1,675
600# 4–8–6	1,929	1,700	1,339	1,789	2,211	2,045	1,624
600# 4–8–4	1,648	1,502	1,227	1,686	2,006	1,886	1,512
600# 4–8–2	1,288	1,418	1,204	1,434	1,651	1,662	1,318
600# 4–8–0	858	1,172	957	1,137	1,197	1,142	1,047
600# 8–8–4	1,556	1,606	1,410	1,653	1,811	1,768	1,468
600# 6–8–4	1,637	1,586	1,334	1,664	1,889	1,875	1,507
600# 4–6–4	1,549	1,609	1,197	1,600	2,053	1,757	1,472
600# 4–4–4	1,629	1,586	1,220	1,530	1,795	1,866	1,412
No fertilizer	895	912	723	1,000	1,005	1,050	910

* No fertilizer applied in 1932.

farmer uses, perhaps the 8 per cent more nearly expresses the potassium needs of these particular soils on the basis of the average farm application. However, both of these soils are higher in fertility than the average bottom soil, and in general the average bottom soil will give a much greater response to nitrogen and phosphorus. Since there were no 0-8-4 or 4-0-4 treatments in either test, how much response is being secured from nitrogen and phosphorus cannot be determined, but most experiments have shown that they are essential to cotton fertilization even in the bottom soils.

Fertilizing Potatoes in New England

(*From page* 9)

not been so wide as they were during the first. This is undoubtedly accounted for by the strict rotation followed and by the lack of "hunger" of the soil itself for applied fertilizers. In other words, variations caused by fertilizers, either one or more elements, are likely to be greater in a long rotation with infrequent fertilization than in a short rotation where plant food is applied frequently. Furthermore, variations in yield will be much greater in a good potato climate.

The check plot yields during the first period on the Jackson farm averaged 393 bushels per acre, and in the second period they have been 384 bushels. Contrast with these yields, those of the Lane farm in southern New Hampshire where a test similar to that of the first period on the Jackson farm has been in progress for 6 years and which has had corresponding yields of but 244 bushels per acre.

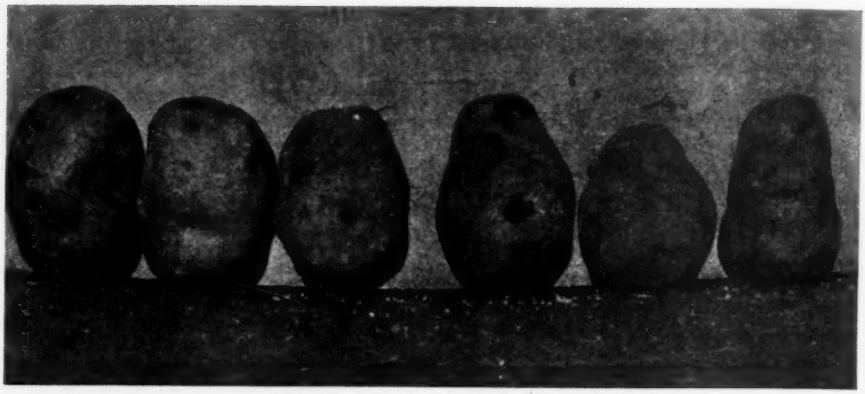
As I have already indicated, yield differences for varying treatments have not been nearly so wide; yet they have followed the same general pattern on the Lane as on the Jackson farm. Omitting the phosphorus and potash in 4-0-7 and 4-8-0 fertilizers has caused annual decreases of 42 and 59 bushels respectively over a period of 6 years, while doubling these elements in a 4-16-7 and a 4-8-14 has given increased yields of 14 and 15 bushels to the acre. These increases are not so striking as those secured on the Jackson farm, but they do indicate that even with low yields additional potatoes can be produced with more plant food and especially with phosphoric acid and potash. Two of the seasons on the latter farm have been very unfavorable for potatoes, and yield differences were very slight in spite of fertilizer treatment.

Fertilizer Recommendations

While we do not lay claim to having as yet found the ideal fertilizer ratio for potatoes, we are inclined to believe after conducting these two experiments that the 1-2-2 ratio is not ideal for the crop, but that the phosphoric acid and potash should be moved up to a 1-2½-2½ or even to a 1-3-3 ratio, especially for the system of long rotation farming which is practiced over a great deal of New England. We would not agree that a farmer should go to the 4-16-14, which is essentially a 1-4-4 ratio, any more than we would urge him to use a ton and a half of fertilizer. But we do believe that the ideal fertilizer for potatoes, for a great many farms, is somewhere between the 1-2-2 and the 1-4-4 ratios, just as we believe that most farmers can afford to apply a little more than a ton of fertilizer per acre, especially if they are commercial growers and using no manure.

There is a quality factor involved, too, recent tests here indicating that high minerals make for a better cooking potato. This is a thing that sooner or later will be taken into account.

Nor can we overlook the fact that to avoid scab, potatoes must be grown on acid soils and acid soils having a higher fixing power for nutrients than those to which lime can be applied



Influence of manuring on the shape of potato tubers. Left: Round tubers resulted when fertilizers high in potash were used. Right: Tubers long and tapering at the crown end resulted when fertilizers high in nitrogen and low in potash were used.

freely. Moreover, the growing season when potatoes do their best is short and soil processes are not particularly active. All of this means that the crop must be fully fed if it is to bring the highest returns.

Neighboring With Nature

(*From page* 5)

thinned timber stands, more rotation pastures, grab and grunt, scheme and plan—anything and everything must go to make room for the cows and the sows and the pickings for the chickens. Rustic scenery means rusty tools, and competition is the foe of contemplation. The farmer's whiskers and the backwoods glades have gone a-glimmering together in the wake of the dollar dilemma. Not *all* the slums are in the cities.

Farm folks up our way mostly regard the woodlot as a cow pasture or a source of cordwood and maple syrup. Finding that pasturing the timber tracts is not sensible economy, they perhaps go in for a thorough course of elementary forestry and clean the place of every dead, hollow, or defective tree. This is bad practice if they want to be good neighbors to the small wild life frequenting their farm.

Raccoons need hollow tree trunks for their dens. Ruffed grouse require "down" logs on which to perform their echoing drum notes. The squirrels, the rodent-eating owls, the insect-destroying woodpeckers, the chickadees, and the blue-birds like dead wood for their breeding places. Tree swallows and certain warblers prefer dead willows on the fringes of damp marshes. Wood ducks nest abundantly in the cavities found in decaying trees along the creek-banks. Where a hollow tree has fallen over so that its branches enter the water, some nosey and inquiring otter may find it and fix it up snug for the puppies.

Years ago our folks depended on finding a bee tree to get their share of sweets. So any stout hollow bowl may harbor a swarm, even in these days when we go to groceries for our sugar. Indeed, the woodcutters might remember such things when doing their tasks, and perchance remove a hollow section from a fallen tree and "transplant" it on another sound and upright trunk, facing south and ready to receive the ancient clansmen of the claw.

Thus equipped with den dormitories for your retiring and modest woodsy

neighbors, the old farm takes on new meaning. Indeed it will make the story-book adventures of the children more real and vivid, if they are taken by the hand to look in silent admiration at the haunts of their heroes from the Uncle Wiggly books. How may nature be taught to better advantage? And along with the lore of nature must come some finer and nobler aspirations, an honest way to give the kinds a wholesome start, you may be sure.

Upland game birds are the delight of the rural landscape. To see a covey of them rise and flutter across a brownish meadow flecked with snow banks is a heart-warming spectacle. But too many farms neglect their opportunity to coax these birds to spend the winter there. The corn or grain that they require for inward satisfaction is easy to provide, but it is lack of suitable cover that kills them off and forces us to curb our hunting spells.

VEGETATION must be tall and stiff of stalk, as well as thick and protective. Snows must not bend it over and matt it to the soggy earth. This is the sort of cover the wild birds seek and many farmers forget to grow it or arrange it. The cover system to be effective should enlist a whole neighborhood in its planning. One farmer to provide a bunch of cover is a good beginning but not enough. I find that more wild bird covers were supplied in my State this past winter, coupled with feeding stations, than in any season known to modern times. We are slowly learning to be considerate of feathered guests, and they will thank us just as effectively as they did the pioneers. As the utilitarians might say, "It improves the shootin' too."

Too many marshes are completely burned over, mowed clean, or grazed. This disturbs nature's wildlife balance. Up north the wild growth of willow, alders, and dogwood bushes helps form the nucleus of a good bird cover, and they form a beautiful color pattern along the marsh boundary. One may even hasten the bush-growing process by setting out young cuttings early in the spring.

Wild grape vines afford another excellent source of thick covering to shelter the upland birds and their kin. An Indian tepee made of stout poles interlaced with strands of wire may also be used to give a foundation on which a sprawling grape vine may tangle its branches, weaving a web of close fitting protection for the feathered friends. Of course livestock meandering through the pasture will tear down some of the vines, so a section of fence should surround it. The feeding stations of corn and grain may be established near the shelters.

DROUTH stricken farmers of the western dust bowl learned amid hardships to appreciate the value of ponds. Since their disaster the government engineers have helped them build artificial ponds. My nature-loving friend suggests that "some day Dakota may build as many ponds as Wisconsin has drained." That tells the story in a nutshell. We neglect the natural resources given to us as pioneers and live to see others regard such things as treasures.

In many States it is unlawful to use live decoys or bait on a shooting pond, but if we are going to be real conservationists this pond of ours will not be one where guns are blazing away. With shooting excluded, the spring job is to put in a few live decoys, probably wild ducks with wings clipped, and bait the spot with corn. Rough fish or carp may steal the grain if it is in the water, but that is where the diving ducks prefer to find it. A sort of bar or water bank is often made by hauling gravel out over the ice late in the winter, and this enables grain to be placed beneath the pond surface.

A raft anchored in the center of the pond will attract terns and gulls. Some old tree snags with their limbs peeping out over the pond make a great perch for the wily kingfisher, who spends so much time keenly eyeing the denizens of the deep. He must have a nesting spot near by, and any old gravel bank

where holes can be dug is likely to attract his domestic inclinations.

The most striking benefit one gets from a farm pond is the ever-changing rush of busy visitors, some from South America, en route onward to the polar zones, and others from Cuba who pause on their migration to Ontario. Some of them will jot down the location of your pond somewhere in those mysterious noodles of theirs, and behold, another season finds them back again, flapping and paddling in joy and appreciation.

By that time, to know your vagrant friends the more, you will want a copy of Circular 363 of the Federal department of agriculture, written by Fred Lincoln, senior biologist and national authority on the wonderful migration routes of all the principal species. Folks who imagine themselves to be regular of habit and quite some traveled in a distant way will find their records shattered by the eery birds of passage.

THE unerring certainty with which the migratory birds travel on the same or similar flyways both going and coming, resting at last in the same locality without fail, is one of the mysteries that challenges the admiration of beholders.

Is this ability to follow a definite path to a fixed goal an inherited faculty, or is it taught to the younger birds by those which have migrated before? This theory they say does not hold true in species where the young and old fly at different times separately.

The mystery becomes even deeper when we recall that a majority of the birds migrate by night and many of them cross vast open stretches of the ocean. How can birds flying at thousands of feet above the earth recognize terrestrial features of the landscape sufficiently to guide them on their way? Again we have records of migratory fowl which have been known to shape a true and scientific course through deep fog to reach their distant destination. We know of no biologist wise enough as yet to tell us all there is to learn of our flying friends.

Man has yet to beat the bird in flight, despite the wonders of the airship lanes. Birds possess the finest natural mechanism and bodily structure for sustained flight that nature has perfected. Hollow bones, light and tough feathers, and a rare economy of fuel, combine to give them much that man will never build into his artificial soaring.

MOST remarkable among all migrants is the golden plover, which travels the whole distance from Nova Scotia to South America along the sea for 2,400 miles, making this great nonstop run in about forty-eight hours of continuous flight. It does this feat on two ounces of fuel in the form of body fat. To be as economical as this, our modern airship must burn one pint of gas in twenty miles instead of one gallon.

Just such simple but challenging things as these, which are old as time but ever new, should cause us to be anxious to make peace with the creatures of the wilds. As rural dwellers in spots most apt to see their recurring visits, we have a favor granted to a relatively minor share of our population.

It seems to me that spring awakens this desire in us anew, to get acquainted with the furry friends and cheery songsters. Knowing also that the bulk of them render us untold benefits by insect and vermin eradication, we may disguise our bit of sentiment in a bluster of practicality.

And so I leave you with your April plans and your newly found nesting friends, trusting that the advancing season will shower you both with the largess of the vine and field and bring you gladly with content to the ultimate harvest. And though you may lack cash, you shall have sweet companionship.

MARITAL BLISS

She: "You deceived me before our marriage. You told me that you were well off."

He: "I was, but I didn't know it."

Mrs. Mulcahy: "An' why did yez keep Mickey in after school?"

Teacher: "I asked him who George Washington was, and he only stood and looked at me."

Mrs. Mulcahy: "It's dumfounded the b'y was at yer ignorance, likely."

Big Hen (boastfully): "I get thirty cents a dozen for my eggs. How much do you get for yours?"

Small Hen (meekly): "I get only twenty-five cents a dozen."

Large Hen (scornfully): "Why don't you lay big eggs and get thirty cents a dozen, too?"

Sandblower Hen (proudly): "Huh! I should exert myself for a nickel!"

NO PLEASURE

Two old Scotsmen sat by the roadside puffing solemnly at their pipes.

"There's no' much pleasure in smoking, Donald," said Sandy.

"Hoo dae ye mak' that oot?" questioned Donald.

"Weel, if ye're smokin' yer ain bacca, ye're thinkin' o' the awful expense, and if ye're smoking some ither body's, y'r pipe's rammed sae ticht it winna draw."

"Where have you been, Bill?"

"In a telephone booth talking to my girl, but drat it, someone wanted to use the telephone and we had to get out."

"Mother," said a little boy after coming from a walk, "I've seen a man who makes horses."

"Are you sure?" asked the mother.

"Yes," he replied. "He had a horse nearly finished when I saw him; he was just nailing on his back feet."

Salesman: "Boy, O boy, did Tillie throw a party last night!"

Girl: "You don't say! Who all was there?"

Salesman: "Just me and Tillie."

SHE FORGOT

"Rastus," said the judge, "your wife complains that you never work. How about it?"

"Dat woman's crazy, judge," replied Rastus. "Ask her what Ah was doing de second Toosday in July last yeah."

Two American boys were on a visit to their cousin in England.

The visitors were boasting about their respective fathers.

Said one: "My father built the tallest skyscraper in the States. Look me over, boys—look me over."

"That's nothing," remarked the second. "My father designed the largest air-liner in the world. Look me over, boys—look me over."

For a second or two their English cousin remained silent.

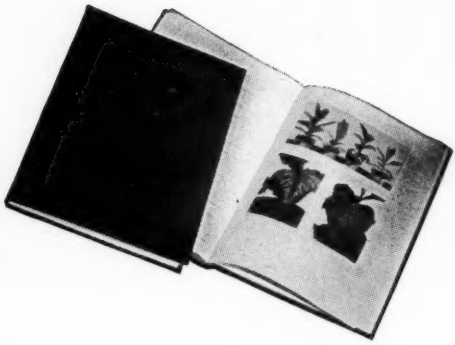
"Well," said one of the cousins, "with what remarkable achievement can we credit your father?"

"Look me over, boys—look me over," came the quiet answer.

Constable (to gentleman staggering home at 3 a. m.): "Where are you going at this time of night?"

"To a lecture."

POTASH DEFICIENCY SYMPTOMS



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